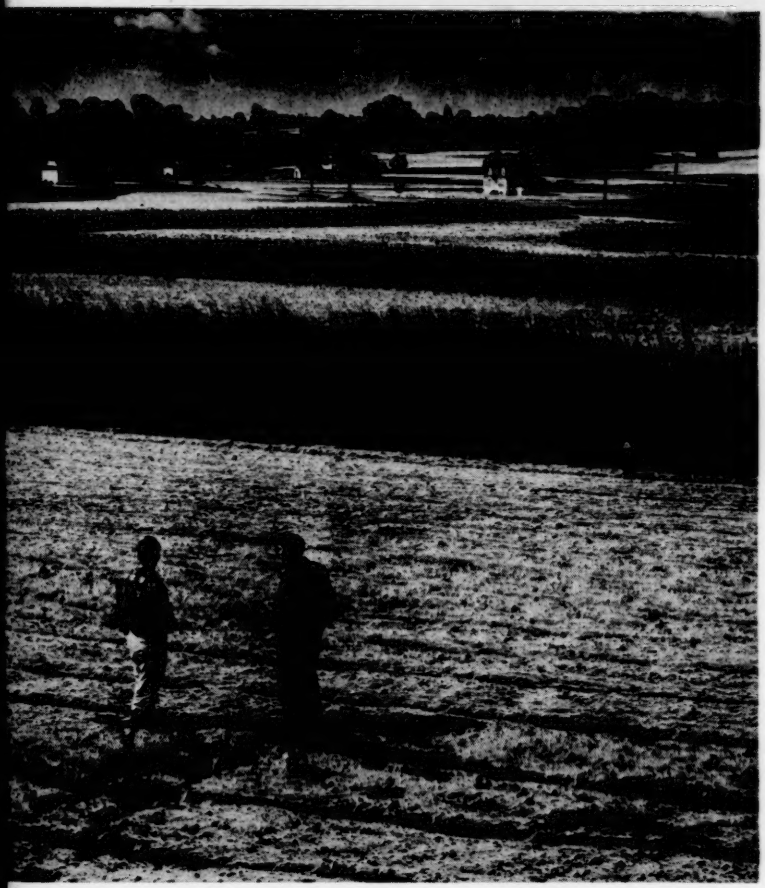

Volume 11, No. 3 **May, 1956**

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. . . N. W. Hudson

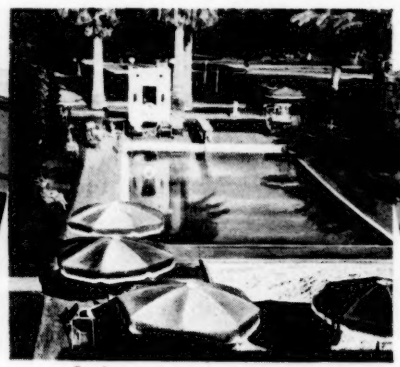
Watershed Resource Management
. . . Robert G. Struble and A. R. Croft

Eleventh Annual Meeting, Soil Conservation Society of America—Tulsa, Oklahoma, October 15, 16, 17, 1956.

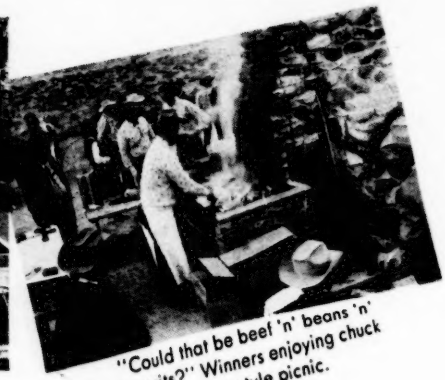
ANOTHER YEAR—100 SUPERVISORS, FARMERS AND RANCHERS IN ALL STATES CAN WIN

Goodyear All-Expense-Paid Vacations!

A bit of the colorful Southwest greets winners on arrival.



Pool, terrace and game areas—part of winners' Arizona playground.



"Could that be beef 'n' beans 'n' biscuits?" Winners enjoying chuck wagon style picnic.

Winners getting low-down on most modern irrigation methods.

"Pick me a gentle one!" Winners off for a morning cow-pony canter.

"Go get 'em, cowpoke!" Winners enjoying impromptu rodeo.

4th Year of Goodyear's National *Soil Conservation Awards Program Started May First!*

WOULD YOU LIKE to be among the 100 winners from all 48 states to enjoy all-expense-paid vacations at Goodyear Farms, Litchfield Park, Arizona?

Each winner, on arrival, gets western clothing to keep —and the lively program includes swimming, riding, golf, mountain and city tours, movies, desert barbecues, illustrated talks—and inspections of Goodyear's most advanced farm operations.

Other awards include handsome bronze plaques to outstanding soil conservation districts—and framed Certificates of Merit to outstanding co-operators.

No matter where you operate in continental United States, you may compete – and there's still time to enroll. For all details, without obligation, contact your local Soil Conservation district office.

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With exclusive All-Wheel Drive for maximum tractive effort; exclusive All-Wheel Steer for unequalled maneuverability, and with its heavy-duty bulldozer, the Austin-Western Power Grader is a top performer on a wide variety of soil and water conservation practices. Equally important is its ability to move earth *fast* . . . excellent insurance that all portions of a farm plan that should *function* together will be *finished* together—*on* time and *in* time. The whole story is yours for the asking—and well worth reading.

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Raking Magic

New Ford Mounted Side Delivery Rake

Here is another Ford-designed implement that is bringing new speed, new ease to hay making.

First, you'll notice the new Ford Side Delivery Rake is designed for modern "pick-up-and-go" farming. The entire rake "rides" to and from the field. Nothing drags behind to wear, to cause delay. And when raking, you can quickly lift the Ford Side Delivery Rake over obstructions . . . make short turns without cramping . . . rake cleaner on the curves . . . back into tight spots easily. But that's not all.

This new, improved rake moves hay a shorter distance from swath to windrow than ordinary side rakes. There's less whipping, less tossing of hay. It handles hay gently while raking at faster speeds. And its extra width gets all the hay with ease, placing the raked hay on top of stubble for faster curing.

There's much more, such as the exclusive four-blade rotor that strips hay from the teeth uniformly cleaner . . . two-speed PTO drive for all raking conditions . . . and nearly all bearings are sealed-for-life, greatly reducing the "greasing up" chore.

Through machines like this . . . better machines for better farming—Ford is helping farmers meet today's increasing challenges and tomorrow's greater opportunities.

The Ford Mounted Side Delivery Rake is raised and lowered by Ford Tractor hydraulic power. The rake "rides" to and from the field. It can be quickly lifted over rocks to avoid damage . . . turns can be made without cramping . . . backing is easy.

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FORD MOTOR COMPANY,
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Ford Farming
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VOLUME 11
NUMBER 3

Journal of SOIL AND WATER CONSERVATION

TO ADVANCE THE SCIENCE AND ART OF GOOD LAND USE

This JOURNAL is the official organ of the Soil Conservation Society of America. It is owned, edited, and published bi-monthly by the Society.

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Contents for May, 1956

The Southwest's Great "Bluestem Bowl"
MYRON A. HURD..... 109

A Simple Erosion Demonstration Machine
N. W. HUDSON..... 114

Control of Keams Canyon Wash
WILLIAM H. BERRY AND ELMER HASSIG..... 117

Watershed Resource Management
ROBERT G. STRUBLE AND A. R. CROFT..... 121

Soils and Watershed Protection
G. W. MUSGRAVE..... 125

Obstacles to Conservation
PAUL J. ZWERMAN AND JULIAN PRUNDEANU..... 127

The Sense of Using Dollars in Soil Conservation
ELMER L. SAUER..... 130

Factors Affecting Runoff from Forest Land Under Extreme Climatic Conditions
GILBERT L. VARNEY..... 132

1955 Flood Damage to Land in the Northeast
N. PAUL TEDROW AND ARTHUR B. BEAUMONT..... 136

Book Reviews..... 139

Field Notes..... 141

News Notes..... 144

Some New Industry Products..... 148

Cover: This late spring scene shows alternating contour strips on the John Ripple farm near Millersville, Maryland. It is here where upstream flood prevention begins.

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Two Important Phases of
UPSTREAM WATERSHED DEVELOPMENT

Farm power contractor, William Kubik, Wahoo, Nebraska, is doing much to help farmers control runoff throughout the small watershed areas of northern and central Nebraska. His wide experience with conservation practice . . . his thorough knowledge of soils and water control measures . . . backed by the proper Caterpillar equipment for every job, assures his customers of dams, ponds, terraces and ditches built to specifications at lowest cost.

POND BUILDING . . .

Contractor Kubik's CAT D6 Tractor and No. 60 Scraper are shown loading stiff, yellow clay in this pond bed. In the background, another D6 and 'dozer build the spillway. The dam is 380 'long by 18' high with an 8' crown. The total job involves moving 3600 cu. yd. of dirt from an area covering several acres. Mr. Kubik says, "Cat-built machines are easy to operate, repair bills are low, and resale values are high."*

TERRACE CONSTRUCTION . . .

Mr. Kubik's Caterpillar No. 12 Motor Grader is shown building terraces and waterways to lead the water slowly downhill to pond or drainage ditch. He has standardized on Caterpillar equipment and realizes many benefits: D6 Tractors and No. 12 Motor Grader all have the same basic engines — which simplifies his machine care and operator training. Long-lasting performance and economy of Cat machines help him profit.

Your Caterpillar Dealer is a good man to see when you're planning a soil conservation program. He can put you in touch with efficient farm power contractors in your community and recommend the equipment that can do your jobs best. You can have confidence in the equipment he sells, because Cat machines have cleared more land, moved more dirt than any other man-made power on earth!

CATERPILLAR TRACTOR CO., Peoria, Illinois, U.S.A.

CATERPILLAR*

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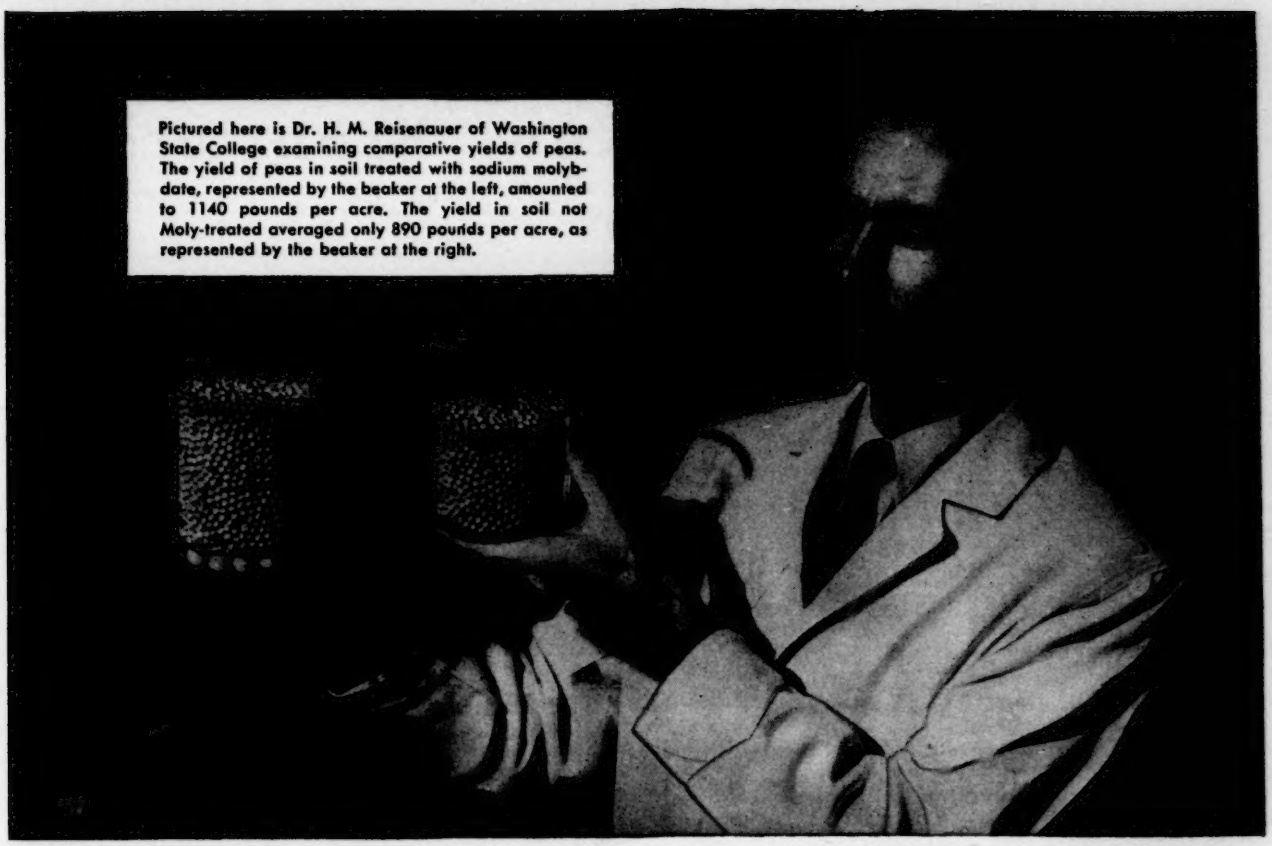


Pictured here is Dr. H. M. Reisenauer of Washington State College examining comparative yields of peas. The yield of peas in soil treated with sodium molybdate, represented by the beaker at the left, amounted to 1140 pounds per acre. The yield in soil not Moly-treated averaged only 890 pounds per acre, as represented by the beaker at the right.

Pea yield increased 28% by use of Moly fertilizer

As a part of molybdenum deficiency tests which have been carried on since 1952, Dr. H. M. Reisenauer is demonstrating the value of Moly in stepping up the size, vigor and yield of peas.

Vigorous plant growth and greatly improved yield in peas have been obtained at the Washington State Experiment station through the addition of trace quantities of Moly. Dr. Reisenauer's experiments have shown that when peas are moly-starved the nitrogen fixation is almost negligible, and the plants are small and poorly developed. Moly deficiency results in fewer pods—lower yield.

By adding sodium molybdate to the soil, Dr. Reisenauer obtained vigorous plant growth and greatly improved yield. The pictures reproduced above tell the story.

Moly deficiency has been definitely proved in many areas in the United States

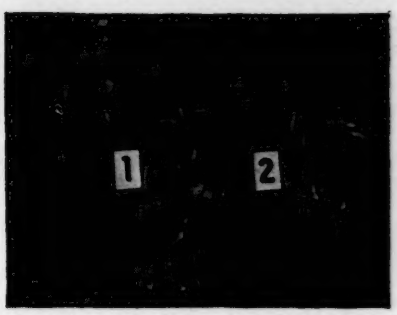
Field observations and tests show that a deficiency of available Moly exists in American soils in many locations. The study of whiptail in cauliflower, for example, has led to the discovery of Moly deficiency in New York, New Jersey, Pennsylvania, Delaware, Maryland, West Virginia and Ohio. Intensive work on yellow spot brought to light a Moly deficiency in the citrus area of Florida. And the incidence of yellow foliage and low protein content of alfalfa has been successfully corrected by the use of Moly on molybdenum deficient soils in South Carolina, Idaho, Washington, and New Jersey.

All crops need Moly

Many other scientific tests, conducted in the United States and abroad, show conclusively that Moly in available trace quantities is needed by all crops. These findings apply to such widely varying crops as tobacco, tomatoes, celery, broccoli, sweet potatoes, sugar beets and clover.

Practical help is now available to county agents for the conduct of Moly tests

In many parts of this country, not previously reported upon, county agents are finding indications of Moly deficiency in soils. We will be glad to supply test samples of sodium molybdate to county agents for test purposes. Write to Climax Molybdenum Company, Dept. 50, 500 Fifth Avenue, New York 36, N. Y., for our new folder: "Testing for Molybdenum Deficiency."



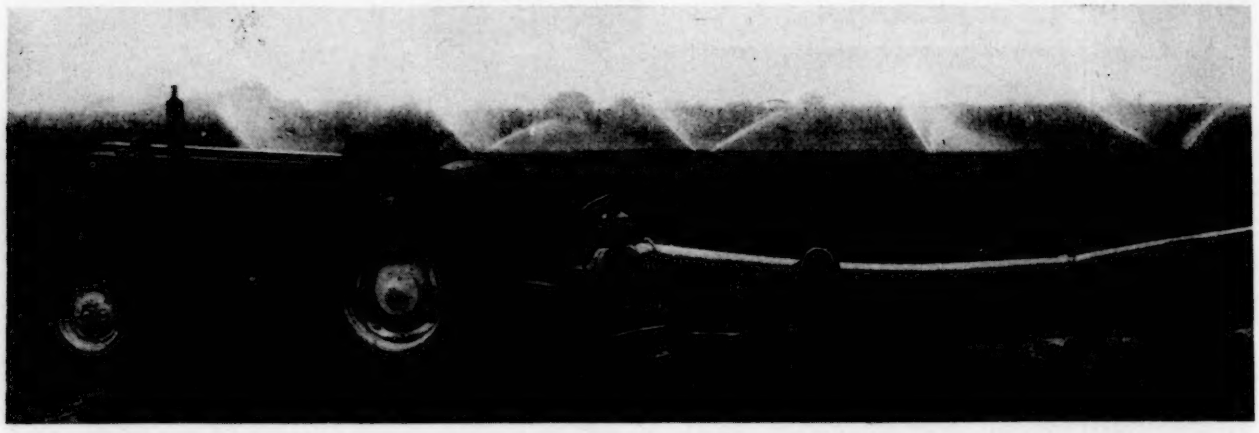
Shown here are pea plants grown in Moly-treated soil (Plant No. 1) and plants from untreated soil.

MOLY CAN BE ADDED TO ANY FERTILIZER BLEND

In recommending fertilizer blends you can always specify that certain quantities of sodium molybdate be included as an additive.

CLIMAX MOLYBDENUM

Is This the New Frontier?



BY tradition, irrigation was for the West—for semi-arid plateaus and fertile valleys where spring comes cool and green, then fades and burns beneath the summer sun.

And that's just another tradition that farmers have broken to smithereens. As long ago as 1900, irrigation was being used large-scale by Louisiana rice growers. As time went on, farmers here and there began to pump from streams and ponds and wells until, in recent years, thousands have turned to sprinkling systems—east, north, southeast, and everywhere between.

WHERE there's irrigation, there's the need to level and smooth the land. One engineer summed up the trend this way: Land leveling moves east—to the Corn Belt and the Mississippi delta, to the Carolinas, to New Jersey, and Virginia.

Here then, indeed, is a new frontier—in the extension of irrigation, in the conditioning of land for better use of irrigation water, and in the adaptation of farm equipment to new tasks.

Irrigation engineers offer this word of warning. The newcomers to irrigation, if they are wise, may well consider this one big lesson from the experience of old-timers in the business: *Irrigation is wonderful, but it's no miracle.* It costs money, and it has its problems—every farmer must learn how best to adapt it to his farm, how to live with it successfully, what equipment is necessary, when to apply water, when not to, and how much.

To the men who are diligent and patient enough to find the answers to such questions, irrigation does offer tremendous possibilities. History proves that.

JOHN DEERE • Moline, Illinois

Waiting on livestock beats self-service grazing

Nowadays turning livestock loose to graze and help themselves may be a costly luxury—where the land is under intensive cultivation.

Many farmers are carrying fresh-cut grass to their livestock *daily*. This is Green Feeding—also known as Soilage, Mechanical Grazing and Zero Pasture.

Green Feeding is the best system *so far* for getting highest productivity per acre of grassland. Feed costs are lowest. More stock can be carried per acre. Or parts of present acreage can be turned to other crops.

How are costs cut? Most farmers agree that grazing wastes a part of the grass in pasture. Estimates go all the way to 25%. Green Feeding eliminates the cause of this waste. Lush early-season forage is not wasted by trampling or animals lying down. And no urine or manure spots which stock avoid.

There is no undergrazing. Some cows get so smart on rotation that they simply top the new grass and bellow to be let into the next field. With Green Feeding they eat every bit, leaves and stems, and the need for supplemental grains and concentrates is held down. There is no overgrazing either. Soil compaction is reduced and plants are not loosened or torn up.

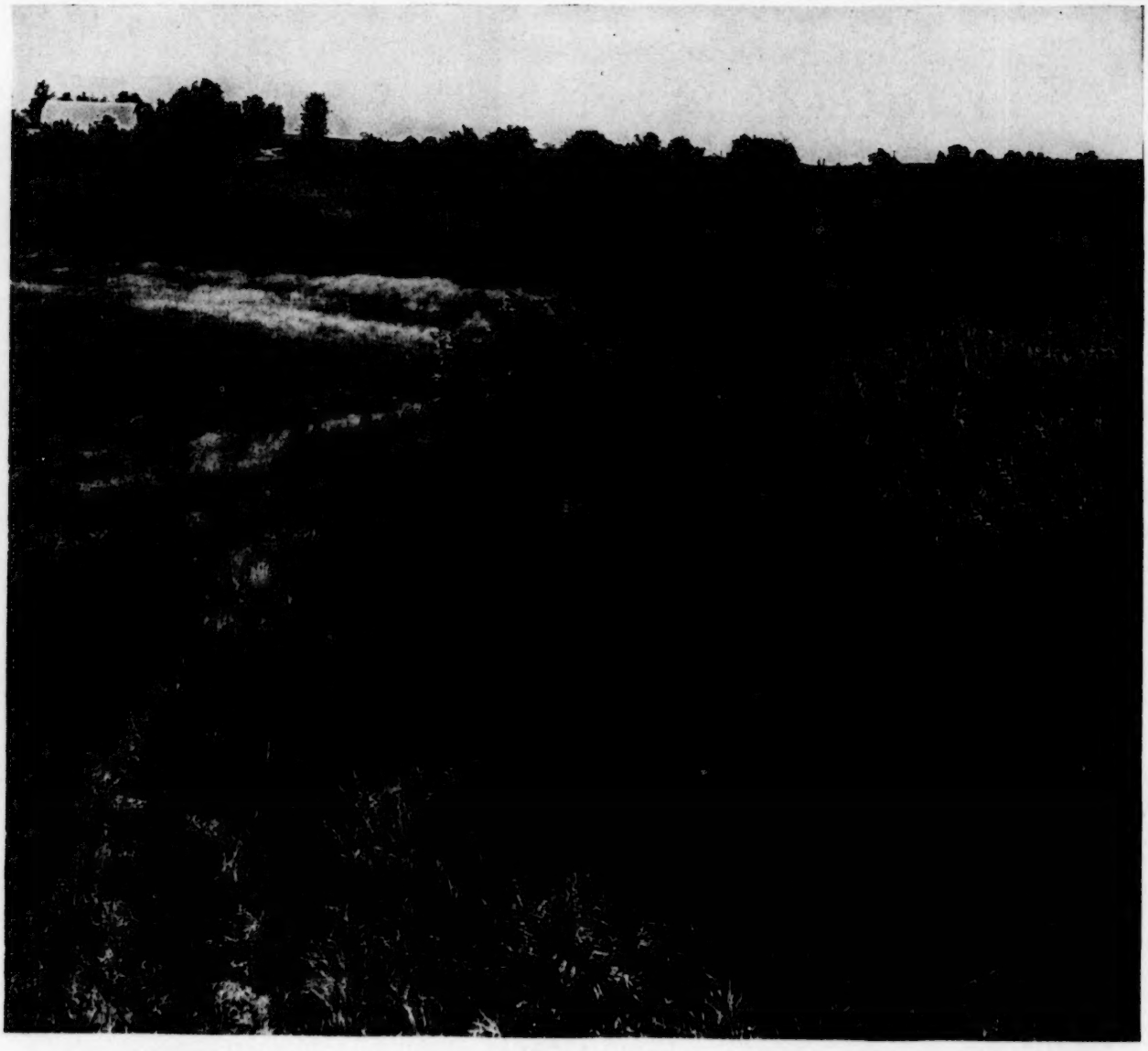
The backbone of a Green Feeding system is the *forage harvester*. You cut and chop the daily ration and feed it directly. The expenses involved—labor, machinery, depreciation, gas and oil—must, of course, be figured against production gains.

New Holland's Forage Harvester with direct-cut attachment chops and loads up to 22 tons of standing forage crops per hour. This hard-working, high-speed harvester is just one of the new and improved grassland machines produced by New Holland to make developments, like Green Feeding, practical.

New Holland Machine Co., New Holland, Pa.

NEW HOLLAND

"First in Grassland Farming"



Fencing by the gallon

It's thorny. It explodes into a million blossoms every spring. So botanists call it *rosa multiflora*. Men who use it say it can't be penetrated by any kind of stock except, maybe, small pigs. So its nickname is "living fence". It should be called "living reservoir", too. Plant it on the contour and it's like building another terrace. Its roots go deep, help the earth store moisture. We can't estimate actual gallons per rod, but the fact is . . . *rosa multiflora* contributes so much to water conservation that you can obtain free plants in most areas. For information, contact your local county agent or Soil Conservation District supervisor. And with modern farm machinery, like Ferguson, other soil and water conservation practices are a simple matter. *Ferguson*, Racine, Wis.

Ferguson

The Southwest's Great "Bluestem Bowl"

MYRON A. HURD

This year's Annual Meeting of the Soil Conservation Society of America will be held in Tulsa, Oklahoma, on October 15-17. Tulsa has been described by some as the "Oil Capital of the World." Others refer to it as the center of the "Bluestem Bowl" which supports many large ranches stocked with fine commercial cattle and registered breeding stock.

The author describes the early condition of the open range and how native "bluestem" grasses helped to build a great livestock economy. He also relates some of the early historical developments in Oklahoma.

As for the present, the author believes that the bluestem grasses with proper management will continue to produce forage as long as there is livestock to harvest it—even long after the great oil reserves are gone.

Mr. Hurd

THE "BLUESTEM BOWL" is a term used by cattlemen in northeast Oklahoma and southeast Kansas, with Tulsa as the principal marketing center, to describe an "Empire of Grass" richly blessed with bluestem grasses. "Bluestem Bowl" is a man-given term, but only Nature, in her process of ecological succession, could cull weaker, less hardy plants from the vegetative composition of the prairies, leaving only the emergent climax bluestem grasses, legumes and forbs indigenous to the area.

The climax plants of the Bluestem Empire represent some of Nature's proudest creations in the plant kingdom. Probably no group of grasses in Amercia has as wide a distribution as the bluestems. They extend from the Gulf to Canada, and from the short grasses of the great plains to the timbered Ozark Mountains of Arkansas and Missouri.

The "Bluestem Bowl" particularly boasts of many large ranches stocked with thousands of head of commercial "white faced" cattle. There are also many ranches raising registered breeding stock. The breeds are mostly hereford, angus, shorthorn, brangus, brahma, and Santa Gertrudis cattle and Quarter horses, palamino horses and appaloosa horses for rodeos and roundups.

Probably no other group of grasses played as vital a role in the settlement of a country, or left a stronger heritage of history and romance, as the bluestems did in settlement of the prairie states. Only pioneers more hardy than the tall prairie grasses could subdue the land, the hordes of wild creatures foraging on the native grasses, and the red man who resisted aggression of his domain.

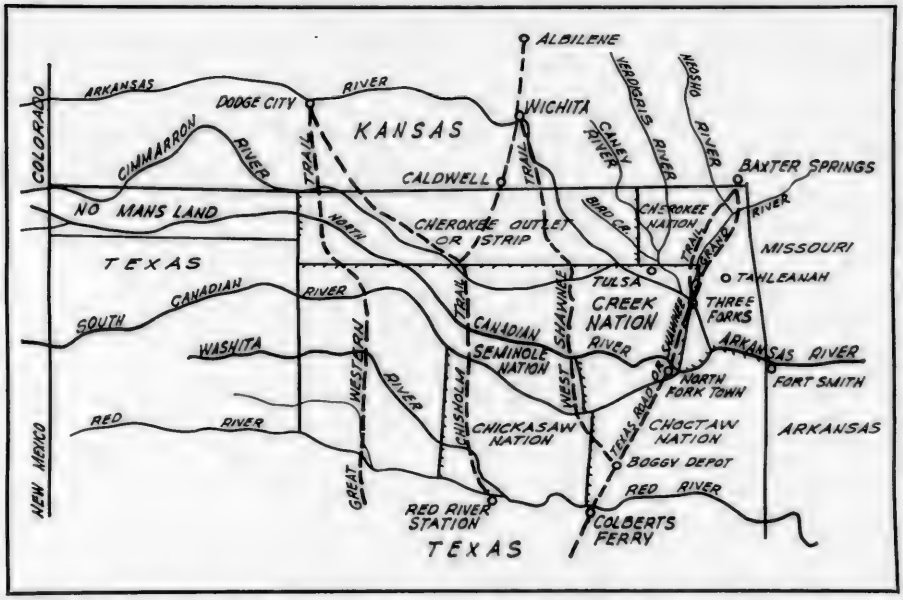


Figure 1. Oklahoma, as it appeared in Indian Territory days, 1868 to 1886, when Texas cattle were driven to railroad terminals in Kansas, fattening on the lush bluestem grasses along the way. The cattle drives continued until about 1886. Baxter Springs, Abilene, Wichita, Caldwell and Dodge City, in about that chronological order, became rip-roaring cattle towns. Tulsa was not founded until about 1882. Oklahoma became a state in 1907.

Myron A. Hurd, an active member of the SCSA, is work-unit conservationist, Soil Conservation Service, Claremore, Oklahome. Mr. Hurd is also Chairman of the Local Arrangements Committee for the 1956 Annual Meeting of the SCSA.

The term "bluestems" is a composite for 25 to 50 species of grasses, forbs and legumes which grew together in varying per cents, according to range sites and condition classes of the range.

The "Big Four"

A prairie upland site, for example, contains a high per cent of the "Big Four" of the range, namely; Big Bluestem *(Andropogon Gerardi (furcatus)*, Little Bluestem *(Andropogon scoparius)*, Indian Grass *(Sorghastrum nutans)* and Switch grass *(Panicum virgatum)*.

A bottomland site will contain, besides these four, a higher per cent of prairie cord grass *(Spartina pectinata)*, *Eastern Gama (Tripsacum dactyloides)*, and the larger sedges and rushes.

A very shallow site (of limestone), in addition to the "Big Four," may run up to 40 per cent of sideoat grama grass *(Bouteloua curtipendula)*. The Savannah site, sometimes called the Cross Timbers or Black Jack Oak site, contains mixed stands of the "Big Four" and other grasses and Blackjack and other hardwood trees and shrubs.

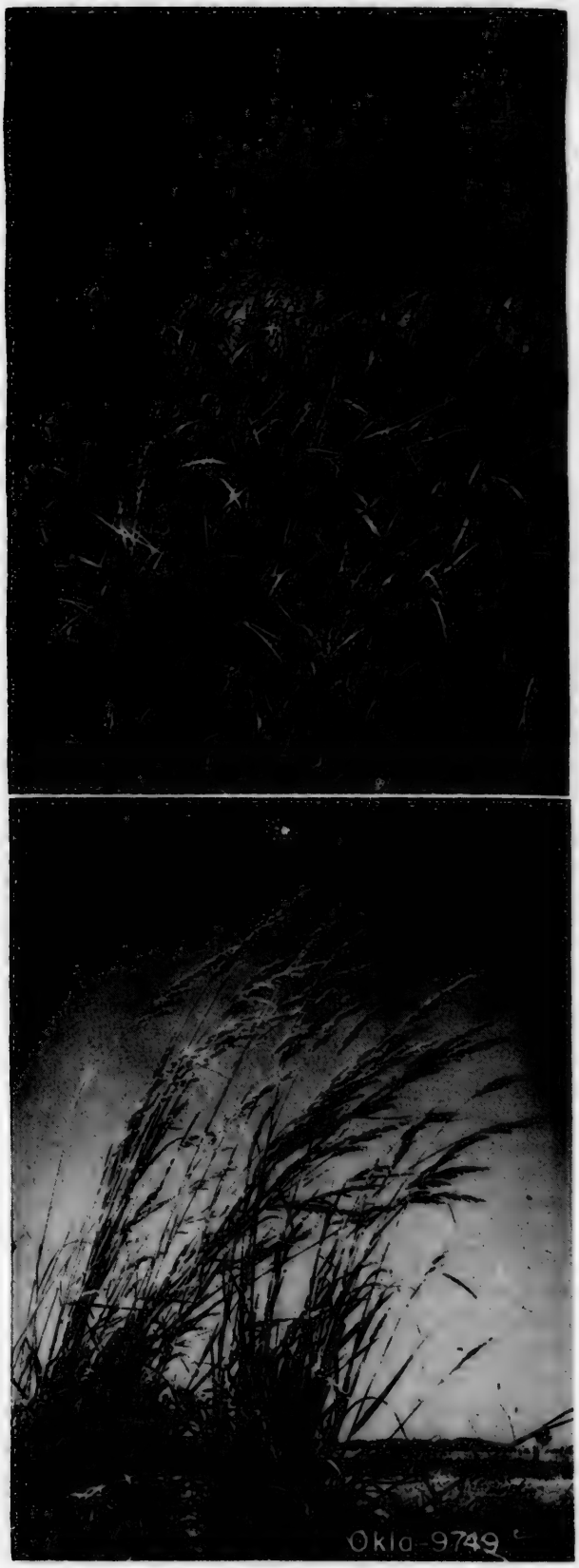
But in all instances the dominant grasses in the "Bluestem Bowl" are the "Big Four," Big and Little Bluestems, Indian and Switch grass, if Nature has been permitted to run her course in development, or if good range management techniques have been employed by the ranchers.

April is the month in Oklahoma when thousands of steers and breeding cattle are moved to the big pastures for fattening or raising their calves on the luscious bluestems. With a stocking rate of four or five acres of grass per steer for four to six months, or seven to nine acres of grass per cow and calf year long, the cattle fend for themselves until ready for market between July and October, or are ready for winter feeding, usually beginning in October.

Most of the ranchers now manage their native grasslands so as to maintain them in good or excellent condition, which means more sustained grazing year after year —more beef per acre in the long run. About 75 pounds of beef per acre of bluestem grass of average productive capacity in excellent condition is considered the maximum which can be secured year after year without damaging the grasses.

Several techniques of management are practiced by ranchers to maintain or improve the range to good or excellent condition. Proper use, deferred grazing, rotation grazing, placing salt in under grazed areas, better distribution of water by building ponds or improving wells, cross fencing, fire control, prevention of overgrazing or trampling of certain areas, and brush control.

Figure 2. *Top*: Big Bluestem Grass (*Andropogon Gerardi (furcatus)*) as it appears along roadsides near Claremore, Oklahoma, during favorable seasons. *Bottom*: Little Bluestem Grass (*Andropogon scoparius*) as it appeared along the roadside near Claremore, Oklahoma, in 1948, a wet year.



While tame pastures often require reseeding, fertilizing, liming, and other treatment, the climax bluestems are able to maintain themselves in excellent or good condition indefinitely with reasonable management.

The condition of native grasses has been known from about 1800 when Washington Irving made his "Tour of the Prairies", in which he described the Empire of Grass, as more of an empire of wild game. Occupied then by the Osage Indians, who lived along the rivers and larger creeks where there was an occasional grove of trees, the area was the Indian's Happy Hunting Ground. It abounded in buffalo, antelope, deer, bear, fur bearing animals, prairie chicken and water fowl. It was this great abundance of game which enticed Pierre Choteau to establish his trading post on Grand River (at Salina) about 50 miles northeast of Tulsa, and the Osages to move down from (Missouri now) to occupy the land.

Pressure from the United States government on the Cherokees of North Carolina, Georgia and Tennessee to move to this area resulted in some of the Cherokees emigrating to Western Arkansas soon after 1800. They began to encroach upon this prairie hunting ground of the Osages and several skirmishes and pitched battles resulted, the final one being the Battle of Claremore Mound in 1818. This mound is eight miles northwest of Claremore and about 30 miles northeast of Tulsa. The Cherokee account of the battle is that the Osage warriors were annihilated. The Osage version is that only women, children and old men were in the Osage village of Pasuga, the men being out on a hunting party at the time. After this battle the Osages retired to their assigned lands, known now as the Osage Nation, which borders the north city limits of Tulsa.

After the Trail of Tears in 1837-40, when the Cherokees were forced by the United States Government to move to their western assigned lands called the Cherokee Nation, Indian Territory, the Cherokees were reluctant to move out onto these lonely prairies amid a veritable sea of waving grasses. They settled instead in the Ozark Highlands of Eastern Oklahoma which were covered with pine and hardwood forests somewhat like their native land. But their hunting parties continued to range over this prairie country, known to them as Cooweescoowee District.

During the Civil War the area became virtually a no man's land, with the Cherokees retiring to Texas or Kansas, according to whether they had north or south sympathies. The area was laid waste, cabin homes were burned, livestock driven off, and it was practically re-

Figure 3. *Top*: Switch Grass (*Panicum virgatum*) as it appeared along the roadside near Claremore in 1948. *Bottom*: Indian Grass (*Sorghastrum nutans*) along a roadside in Rogers County in 1948.

stored by nature during the five years of war to its virgin state.

When the Civil War was over several prominent Cherokee families returned from Texas and built homes, corrals, and split rail fences around a small patch of broken ground for corn. Thus began the subjugation of the prairies. Unable to own land as individuals, it could be used collectively by citizens of the Cherokee Nation. The foundation of many famous Oklahoma ranches was laid during these early formation years. Among the well known names during this era were Rogers, Schrimsher, Lipe, Starr, Foreman, McClellan, Musgrove, Bushyhead, Sunday, Chambers, Cochran, Ward, Bard, Drake, Halsell, Lane, McSpadden, Graham, Crosby and many others.

As early as 1848 Texas cattlemen drove cattle through this area to markets at St. Louis, Chicago and other shipping centers, grazing them on the grass as they went. After the Civil War this became a common practice with the destination being railroad terminals at Baxter Springs, Abilene, Wichita, Caldwell, and Dodge City, Kansas. The trails moved westward as the country became more thickly settled and as railroads extended southwest across Kansas. Evidences of some of these old trails may still be seen on aerial photographs as grassgrown gullies or trails, meandering across the prairies.

Cherokee Strip Opened in 1889

The plow-up of the grasslands began about 1889 with the opening of the Cherokee strip for settlement by white men. After the Indian allotment act in 1898, and statehood for Oklahoma in 1907, the sectioning of land into square miles, and fencing of the land into pastures and fields put a stop to open range. The best land was plowed for crops and too many cattle were placed on the poorer lands for grazing. This resulted in rapid deterioration of the range grasses and rapid invasion by such undesirable weeds and grasses as ragweed, dogfennel, ironweed, annual three awn or wire grass and many others less palatable or durable than the climax grasses.

The intense grazing of the remaining grasslands removed the canebreaks from the creeks and rivers, and the bluestems off the hills and hollows. Tree, brush and weed invasion followed rapidly. Mrs. Dora Tucker of Rogers County describes the Blue Creek area as a sea of grasses in 1895, with no timber or brush to hide wolf hunters and their dogs on the hills south of their home. Now these hills are covered with timber, except where cleared recently. The late Sos McClellan once described the now heavily wooded Blue Creek as having, in 1875, tall prairie grasses which hung out over the deep holes of water with only a tree or a clump of trees occasionally.

Plowing, fencing, annual burning, overgrazing, and the practice of running half-wild range hogs all played important roles in destroying much of the native range in northeast Oklahoma.

Fire was used by settlers and cattlemen to "kill ticks and make the grass grow greener" as well as a weapon used by the settlers against cattlemen to destroy their hay and pasture, often acts of reprisal for the cattlemen's acts of resistance against the plowing and fencing by settlers.

The final assault on the grazing lands came during World War I when wheat reached the unprecedented price of $2.50 per bushel and our allies were calling for more wheat. Farmers mortgaged their farms to buy a second farm at fabulous prices, plowed up all of the native grass to sow wheat, then lost both of the farms in the depression of 1920-21, or the depression of the 1930's. This resulted in a large absentee ownership, and a system of tenant farming, which resulted further in destructive grazing practices.

For the most part, the large ranches of today consist of lands with soils too shallow, or terrain too rough to plow, with farm units incorporated which have been abandoned by the owners through the years, or by purchase of unrestricted Indian lands. Some early Cherokee citizens encouraged negro freedmen, who had full status as citizens after the Civil War, to build cabins on choice grazing lands, then lease the lands to them. After statehood, they bought out or scared out the negroes to gain control of their lands. By this means some were able to assemble large ranches with choice grazing lands.

Most of the native grass range was in poor to fair condition after the severe drouths of 1910-1911 which continued through 1920, except for the wet year of 1915. The drouths of 1930 through 1939 completed the range grass deterioration for most native grass meadows and pastures. One native meadow in Haskell County appeared to be killed out at the end of 1936 and looked weedy and in poor, or at best, fair condition in 1937. However, this meadow made a remarkable recovery in 1938 and appeared to be in excellent condition by the summer of 1939.

This illustrates the remarkable ability of the deep rooted, native bluestem grasses to recover from adversities such as drouths, fire, freezes, and overgrazing. *It seems that only the plow and continuous cultivation can destroy the bluestems. The most seriously overgrazed, weed and brush infested pastures with little or no apparent permanent grasses left, contain remnants of bluestems which make a rapid recovery and overcome the weeds, and in some instances the brush, if the range is rested, or if grazing is deferred and regulated.*

The renowned Kansas senator, John J. Ingalls, long ago eloquently expressed in his *Tribute to Grass*, this

Figure 4. *Left*: Commercial herd of whiteface cattle (grade herefords) grazing native grass pasture in northeast Oklahoma, a typical scene in the "Bluestem Bowl." *Right*: The native bluestem meadow on left side of fence and the native pasture on right side are both in excellent condition, the result of proper use and management.

remarkable capacity of climax grasses to repossess their native habitats.

"Grass," he said, " is the forgiveness of Nature—her constant benediction. Fields trampled with battle, saturated with blood, worn with the ruts of cannon, grow green again with grass, and carnage is forgotten. Streets abandoned by traffic become grassgrown like rural lanes and are obliterated. Forests decay, harvests perish, flowers vanish, but grass is immortal."

Ranchers think of tall prairie grasslands in terms of carrying capacity. A prairie site in excellent condition should carry a cow and calf yearlong for each seven to nine acres, or a steer for four to six months for each four to five acres. By excellent condition is meant that 75 to 100 percent of the vegetation is desirable, palatable, climax grasses, forbs and legumes.

The range is considered in good condition if 50 to 75 per cent of the vegetation is composed of the palatable climax species. It is in fair condition if only 25 to 50 per cent is of the desirable vegetation and in poor condition when less than 25 per cent of the vegetation is of the preferred species. Table 1 shows the recommended stocking rates for the principal range sites and condition classes.

Table 1. Table showing acres of native bluestem pasture required per cow and calf year long for each of the four range condition classes and for each of the three principal range sites in northeast Oklahoma.

Condition class	*Prairie site acres per cow*	*v. shallow site acres per cow*	*Savannah site acres per cow*
Excellent	7-9	13-16	15-18
Good	10-13	17-24	19-29
Fair	14-25	25-40	30-40
Poor	26-over	41-over	41-over

A prairie site is a deep upland soil. A very shallow site has less than 10 inches of topsoil, rocks usually showing. A Savannah site may be shallow or deep soil, of mixed timber and grass. Excellent condition means that 75-100 per cent of the vegetation is climax grasses, legumes and forbs. Good condition means that 50-75 per cent of vegetation is composed of the desirable climax plants. Fair condition means that 25-50 per cent is of the above vegetation, and poor condition means that less than twenty-five percent of the vegetation is of climax species.

Abusive grazing practices were the custom until soil conservation districts were organized from 1938 to 1945, and range technicians of the Soil Conservation Service began to work with ranchers on range improvement practices. Most ranchers are now doing a good job of managing their bluestem grasses for maximum production. They realize that a reserve of grass is good insurance of a sustained grass crop. They follow the rancher's rule *"Take half—leave half"* of the grass. A grass reserve, they say, is like money in the bank, it is there if they need it.

In the efforts of ranchers to improve their ranges, Nature is on the side of the ranchers. The native bluestems have the production potential and the tendencies of climax species of plants to crowd out competitive species. And the liming, fertilizing and land preparation so often necessary in establishing tame pastures is not only unnecessary in the case of the bluestems, but may actually prove harmful, perhaps because of the tendency of annual plants to respond more rapidly to fertilizers applied near the soil surface. Furthermore, liming and fertilizing of native grasses is generally frowned upon because of the tendency of cattle to overgraze the treated areas the same as they do burned over areas, probably due to the increased growth of annuals in the early spring.

Nature endowed this area with rich oil reserves which bestowed upon Tulsa the title "Oil Capital." Nature also endowed this land with rich grass reserves on the ground which acquired the man given title, "Bluestem Bowl."

Once the oil reserves are pumped out of the ground they are gone forever for they are irreplaceable. But with proper management, the bluestem grasses will continue to produce their annual increment of forage as long as there is earth, sun, climate and man, and his livestock to harvest it. Our Grass Empire is an endowment. As Mr. Ingalls said, *"Grass is immortal."*

A Simple Soil Erosion Demonstration Machine

N. W. HUDSON

Some of the really fundamental ideas in the control of erosion caused by rainfall, such as the tremendous reduction in soil loss caused by a good surface mulch, can never be effectively put across by talking or writing. A visual demonstration by a working model catches the eye and the attention, and the lesson so taught remains much longer in the mind's eye of the audience. To demonstrate some basic principles to small groups at Farmers Days, Young Farmers Meetings, and at District Agricultural Shows in Southern Rhodesia the author designed a portable and simply constructed "erosion machine."

THE BASIC components are (1) a rainfall simulator, (2) soil boxes onto which the rain falls and (3) a frame holding the components in suitable display form. The rainfall simulator (Figure 1) consists of a five inch cylinder of light galvanized iron with closed ends and a water supply inlet with tap. Four rows of $\frac{1}{32}$" diameter holes are drilled along the length of the cylinder in such a manner that the pattern of distribution is uniform, and each jet of water intersects another so that it is broken up into droplets. The calculations are given in detail so that they may be modified for other sizes of cylinder or frame. It is required that the jets from the holes of line 1 (Figure 2) describe a parabolic arc of initial angle $\alpha = 45°$, landing at the farthest imaginary line A on the soil tray, 24" from the cylinder. The jets from the lines of holes 2, 3, and 4 land on points B, C, and D which are equally spaced on the soil tray. The holes of alternate lines are in line, but staggered in adjacent lines (Figure 3) so that the descending jets from the holes in line 4 intersect the rising jets from holes in line 2 at point X and both are dispersed into raindrops; similarly jets from the holes in lines 1 and 3 intersect at Y.

To calculate the placement of the lines of holes

Distance of trajectory (D) = K (sin 2 α)
where K is a constant dependent on the velocity of the water leaving the jets.

For line 1 D = 24" $\alpha_1 = 45°$

$\therefore 24 = K \sin 90°$ or $K = 24$

$\sin 2\alpha = D/24$

For line 2, $\sin 2\alpha_2 = 20.24$ or $\alpha_2 = 61.77°$

similarly $\alpha_3 = 69.10°$, $\alpha_4 = 75.0°$

The spacing S on the cylinder between lines 1 and 2 is calculated from

$$S_{1\text{-}2} = \frac{(\alpha_2 - \alpha_1)^\circ}{180} \times \pi \times \text{cylinder radius which}$$

for 5" dia. cylinder $= (61.77 - 45.0) \times \frac{\pi}{180} \times \frac{5}{2}$

$= 0.73$ inches.

Similarly $S_{2\text{-}3} = 0.32"$, $S_{3\text{-}4} = 0.26"$.

N. W. Hudson, a member of the SCSA, is a conservation engineer with the Department of Conservation and Extension, Federal Government of Rhodesia and Nyasaland, Africa. At present, officer in charge of Erosion Control Research, conducting field experiments on runoff and erosion.

Figure 1. This is a close-up of the rainfall simulator in operation in the frame.

It is essential that the holes are all drilled exactly perpendicular to the surface of the cylinder, otherwise the jets will not intersect correctly. It is difficult to do this without setting the cylinder in some kind of jig which allows the cylinder to be rotated about its axis, and in practice sufficient accuracy can be more easily achieved by drilling the holes in a flat sheet which is then rolled to form a cylinder and then the ends soldered on. Very small nozzles to give a spray of water were tried, but a $\frac{1}{32}$" didiameter hole is much simpler and equally effective. Thin (24 ga.) metal is used so that if any jets are out of line they can be straightened by inserting a pin and bending the cylinder slightly. A constant water pressure is desirable, otherwise frequent alterations of the valve are required. If the supply fluctuates, it is worthwhile making a simple constant head tank from a 45 gallon oil drum. With a $\frac{1}{2}$ inch hose a head of about four feet is required. To adjust the "rain" the cylinder is first set so that the bottom line of the jets makes the angle of 45°, then the pressure is adjusted on the valve until the jet lands on the soil box at a distance of 24 inches. At this setting the other jets will give a uniform distribution over the whole soil box.

The soil trays or boxes are 18 x 4 x 6 inches made from lightly galvanized sheet iron with a fold round the top edge for rigidity. A removable false bottom is inserted

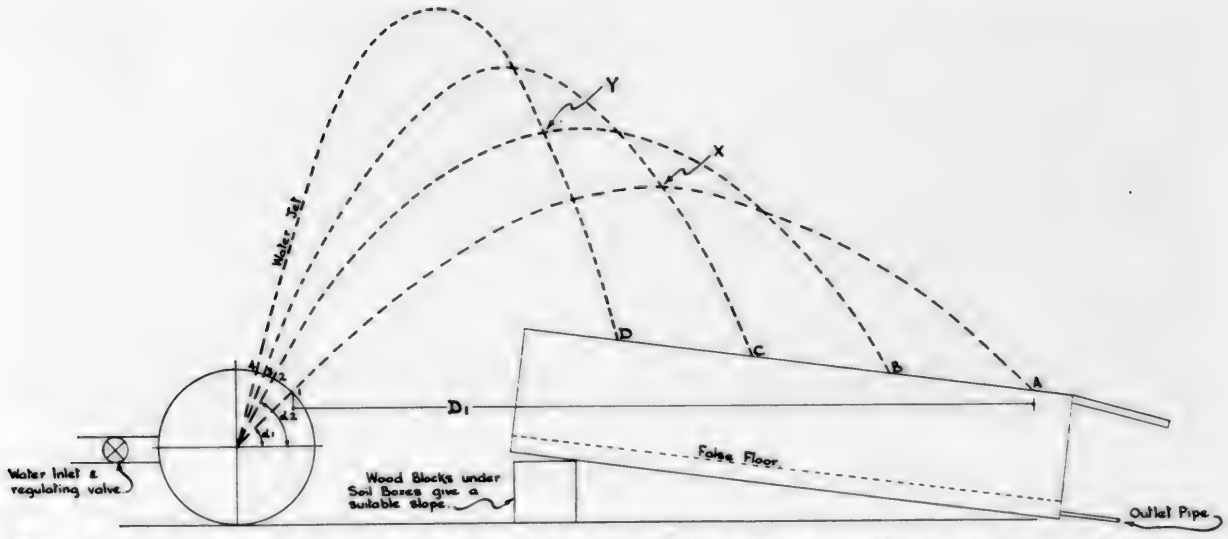


Figure 2. Portion of drilling pattern. 1/32 inch holes drilled in flat 26 gauge galvanized iron which is later rolled to form five inch diameter cylinder three feet in length.

Figure 3. This shows how the holes in adjacent lines are staggered.

of 100 mesh wire screening, the edges bent down to rest on the bottom of the box, and raise the mesh about ½ inch from the true floor. A short piece of ¼ inch copper tube is inserted in the end wall of the box below the mesh floor, and leads off the water which percolates down through the mesh. A metal lip is attached to the same end wall ½ inch below the top, and when the box is filled with soil up to this lip, the surface runoff is collected as it comes over the lip.

The frame can be constructed to any size and of any available materials. The model illustrated is all metal. The legs and braces are of light angle iron with a thin sheet metal cladding. In operation the rain cylinder is placed in the back of the frame with the valve projecting out of the back, and the cylinder and soil trays rest on the floor of 100 mesh screening. The rain which does not fall onto the soil boxes passes through the screen into a collecting tray beneath. This collecting tray extends the full width and depth of the frame and is made watertight where it joins the sheet metal covering of the frame. A slight fall on the tray leads to an outlet with attachment for a ¾ inch hosepipe to take away the waste water. A threeway connection on this hose also picks up the waste water from the little tray at the front of the machine, on which stand the glass jars collecting the run-off from the soil boxes. This tray is also of light sheet metal soldered water-tight at the bends, and collects any overflow from the glass jars. The whole machine is thus self contained and watertight, only requiring ½ inch hose pipe for the water supply, and ¾ inch hose for the outlet, and can be used inside buildings without drips on the floor, or special drainage facilities. A sheet of glass fitted in each side of the top part of the frame is desirable to avoid odd splashes of water, and a plywood surround sets off the general appearance, and forms a background for photographs and display material.

The Machine in Operation

Two of the soil boxes are filled with suitable soil up to the level of the outlet lip: That is ½ inch from the top, and packed down lightly. The type of soil and amount of compaction can only be determined by trial and error. A clay loam which has been air dried and passed through a ¼ inch seive is very suitable and settles to the right

Figure 4. *Left:* Soil trays showing loose false bottoms. *Right:* 1. Runoff from mulched soil (left) is slight and clear; 2. Runoff from bare soil (right) heavy and muddy; 3. Infiltration is much greater on mulched soil.

texture if the box is rapped on the floor several times when filling. A wooden scraper is used to level off the soil flush with the outlet. A thin layer of grass clippings is sprinkled on the surface of one box and both are placed in the frame and the rain turned on. The effects demonstrated are:

1. After the "rain" is turned on the run-off starts much quicker from the bare soil, showing the surface detention effect of a mulch.

2. When both boxes have settled down and are yielding surface run-off, the run-off from the bare soil is both greater and more discolored. That from the mulched box is quite clear, and small in amount, showing how the mulch reduces both erosion and run-off.

3. The flow of "percolate" from the bottom tube is considerably greater from the mulched plot, showing that the mulch increases infiltration.

4. After a few minutes the bare soil shows the effect of the raindrops puddling unprotected soil and breaking down the soil particles.

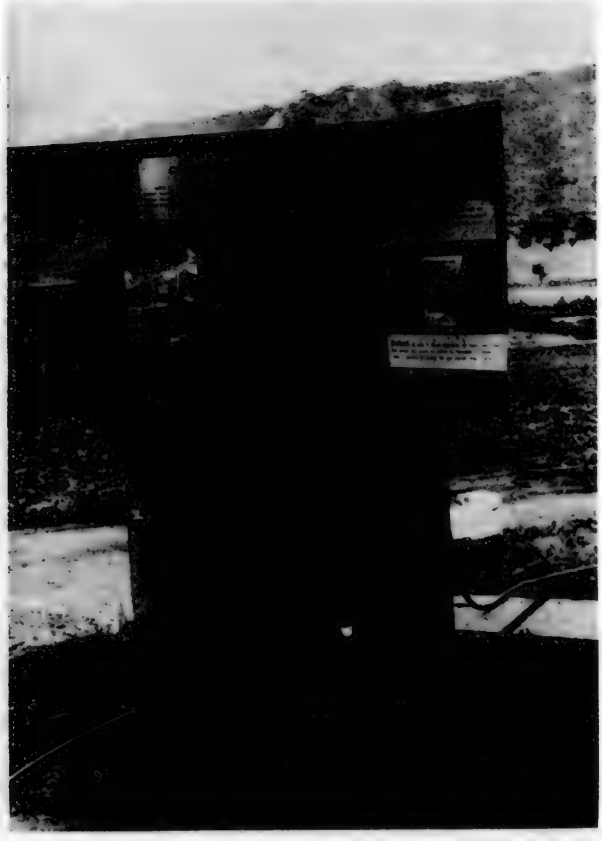


Figure 5. A general view of the Soil Erosion Demonstration Machine.

The boxes of soil are good for a demonstration of about 30 minutes duration, after which the soil sometimes washes through the false bottom, and chokes the percolation outlet. It is good sales talk to have a supply of soil, grass, and spare boxes so that skeptics or wise guys who think there is some trick can be persuaded to fill the boxes themselves. Many variations of the surface treatment are possible—comparison of different amounts of mulch, different types of mulch, laying it on the surface or working it into the surface soil, and all reproduce the field results with surprising accuracy. Growing matter can also be used in boxes sown previously, but the results are liable to be erratic as the water applied to germinate the seed sometimes causes uneven settling of the soil.

An attendant is desirable to change the soil boxes, adjust the water supply, and explain the demonstration, but if suitable captions and posters are provided and the water supply is constant it can be left to run unattended for a few hours.

Control of Keams Canyon Wash

WILLIAM H. BERRY AND ELMER HASSIG

The Keams Canyon Wash is located on the Hopi Indian Reservation in northern Arizona. It is within an area which for many years has contributed, in relation to runoff, disproportionately large quantities of sediment to the Colorado River. It has a drainage area, above its confluence with the Polacca, of 54,400 acres. The area is typical of the transition zone between the Black Mountain Plateau and the deep alluvial valleys sloping southward to the Little Colorado River. This article by representatives of the Bureau of Indian Affairs deals principally with that portion of the main channel where the Wash flows through a section commonly known as Keams Canyon for a distance of approximately eight miles.

THE NAVAJO AND HOPI Indian Reservations which cover an area of 16,000,000 acres constitute about 15 per cent of the Colorado River drainage area above Hoover Dam. From studies made of their condition during the past twenty years a number of significant factors have come to light. More than 63 per cent of these lands were found to be severely or critically eroded. That is to say that each square mile was yielding one or more acre feet of sediment per year. In total volume it was estimated these Indian lands were contributing more than 20 per cent of the sediment entering Lake Mead, although they delivered only about two and one-half per cent of the runoff. A portion of this water and sediment originates in Keams Canyon Wash and finds its way through the Polacca Wash and the Little Colorado River to the Colorado River.

The soil type in the Keams Canyon Wash varies from heavy clay to sand in varying degrees from upper to lower end. The annual precipitation is from seven to twenty-one inches. The lowest was recorded in 1894 and the highest in 1941. At the upper end, elevation 6,800, the Pinon-Juniper association is in evidence; at the lower end, elevation 5,600, mixed grasses.

While the exact date is unknown, the Government established an Indian School in Keams Canyon sometime during the 1800's. The site for the school was selected because of an adequate water supply and the presence of shade trees as shelter against the intense summer heat. During the 1890's, the deteriorated condition of the watershed made it necessary to consider relocating the school. From the inspector who was detailed to investigate we learn something of the watershed conditions and of his reasons for recommending that the school be established on a more favorable site.

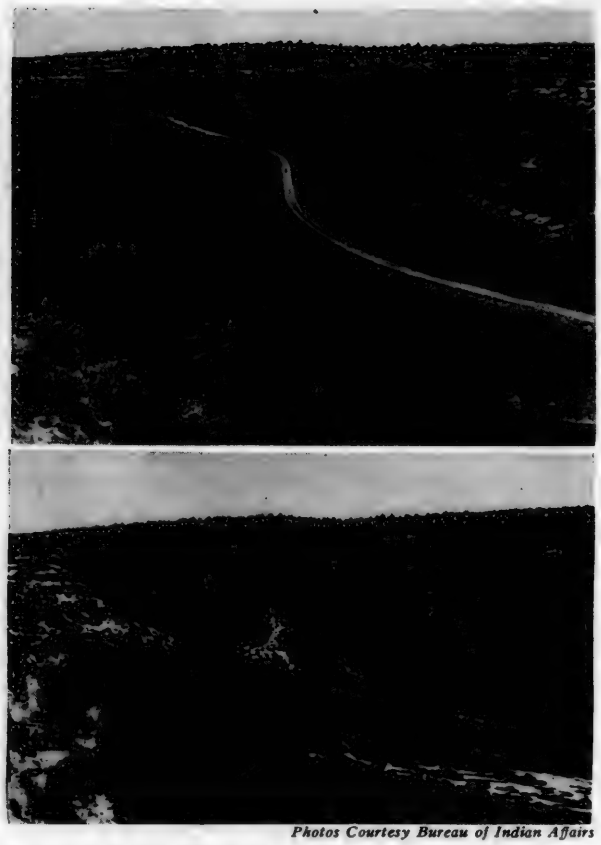
It is reported that in the late 1800's there was no indication of an arroyo in the bottom of Keams Canyon. In fact, there are several Hopis still living on the Reservation who describe it as a flat canyon floor blanketed throughout with tall grasses, evidently as a result of uniform spreading of runoff over the valley floor. A former employee of the Hopi Indian Agency who attended the original Keams Canyon School states that in 1895 the Wash was intermittent, shallow, and quite narrow. This was evident on denuded sections of the valley adjacent to the old school plant, located upstream from the present agency headquarters.

There are indications that many years in the past the Canyon was much deeper. This is supported by the fact that fragments of trees were encountered sixty feet below the present valley floor while drilling a well for water in

Figure 1. *Top:* Photograph taken in 1899—shows original Keams Canyon School Plant which was moved in 1902 due partially to the severe floods that inundated the entire site. *Bottom:* This photograph was taken in 1937. It shows a wash cut to a depth of 37 feet and width of 95 feet.

Photos Courtesy Bureau of Indian Affairs

William H. Berry is a land operations officer and Elmer Hassig is a soil conservationist in the Bureau of Indian Affairs, U. S. Department of Interior. Both men are located in Phoenix, Arizona.



Photos Courtesy Bureau of Indian Affairs

Figure 2. *Top:* Photograph taken in 1947—Illustrates bank sloughing and healing of the scar when aided by vegetation and mechanical structures. *Bottom:* This photograph was taken on January 25, 1956. It shows old Keams Canyon school site as it is today. Both photographs are a repeat of the one taken in 1899.

1946. This point is thirty feet below the existing bed of the Wash. It may be that a severe drought was responsible for the earlier erosion and that gradually, over a period of many years, the floor has built up to its present level. Several authoritatives sources have estimated the age of the wood to be over one million years.

Early History Indicates Land Was Mis-used

The first reports of severe erosion were made in 1898. Letters and reports of school superintendents, Federal inspectors, and word-of-mouth stories told by old Hopis point out there was a period prior to this time when the area was heavily stocked with horses, sheep, and cattle. Friction between the Navajos and Hopis over grazing rights and watering places in this area aggravated by rapidly diminishing forage caused agency officials much trouble. During this period, erosion became apparent in the canyon as indicated by the photograph taken in 1899.

The Hopis claimed that the severe overgrazing and drought during this period denuded the surface of the land and made it susceptible to severe wind and water erosion. The rough, steep terrain, bared of vegetation, poured runoff in abnormal concentrations from the tributaries into Keams Canyon Wash. Water no longer seeped into the earth to replenish the springs below.

In 1901, Mr. Walter H. Graves, inspector for the Indian Service, in his report to the Secretary of the Interior commenting on the periodic floods occurring in the vicinity of the old Keams Canyon School area, wrote as follows:

". . . I carefully examined the valley of Keams Canon and mesas bordering along it, from head of the canon to its outlet, a distance of about seven miles, also the arroyo, stone wall or dike and diverting ditch along the north mesa. . . . I am, at the same time, fearful that from the nature of the soil in this valley, it would not withstand the force of the flood waters of a cloudburst, such as sometimes visits the locality, and therefore submit, that it would be unadvisable to erect an expensive plant at this point. . . .

"The site is very pretty, but building space is limited and apart from an abundant supply of excellent water furnished by several small springs in the vicinity, which issues from the rock walls of the canyon, together with a row of nice cottonwood trees, 156 in number, extending in a single row a distance of about 100 rods along the wagon road. . . .

". . . In two instances within the past three years, water from sudden floods covered the floors of the school buildings, the water being several inches deep in some of the rooms, leaving a deposit of slime and mud to remove after the water had subsided, and the grounds remained soft and miry for some weeks afterwards.

"I desire to state that I do not submit this discouraging view of the present character of the surrounding country, to both of which I have given due consideration, but I also have a personal knowledge of the effects here of the cloudburst flood of July 4, 1898. I passed through Keams Canon, en route from Fort Defiance to Tuba City, about two weeks after that flood occurred, remaining a day in the neighborhood, and saw the damage done by the floods. A new arroya had been cut through the narrow valley for a considerable distance, the school site was inundated and the stain of water and slimy deposit on the inside and outside of the buildings indicated that the waters had been from two to three feet deep in some of the rooms; the floors were still damp and the ground exceedingly soft and muddy. . . ."

It is extremely unfortunate that Weather Bureau precipitation records for the Jeddito Station located approximately five miles from Keams Canyon, dating back to 1894, are incomplete and that the rain mentioned in the inspector's report was not recorded. The flood probably caused the major portion of the erosion evident in 1899.

Photos Courtesy Bureau of Indian Affairs

Figure 3. *Left:* Twin dams located at the head of Keams Canyon. *Right:* Beaver dam in the Keams Canyon Wash.

At least evidence points out that it developed between 1895 and 1899. This relatively small arroyo was a contributing factor in the decision to move the school plant in 1902 to a more favorable location.

From 1898 until 1914, the Wash remained shallow and comparatively narrow. During the summer of 1914 five to eight inches of rain fell in less than one week over the entire Polacca watershed, of which Keams Canyon is a small part. The arroyo was cut to depths that were unbelievable at that time and soil was moved at a tremendous rate. This story was related by one of the local Indians and is substantiated by the precipitation record of the U. S. Weather Bureau data which indicated that 5.8 inches of rain fell during this period at the Jeddito Station near the upper end of the Keams Canyon drainage. Only one storm of greater magnitude has been recorded for this station.

From 1914 until 1935 the watershed was rapidly becoming barren. During this period the erosion along the Keams Canyon Wash was mostly lateral, the result of bank sloughing and overpours. Tons of silt from this source and valuable surface soil from the entire watershed were delivered downstream by this Wash.

Reclamation Work Started In 1929

The first attempt to utilize any of the fast runoff waters was made in 1929 by the Indians. Several dams to impound stock water were constructed by them at the present Bigham Dam site located in the upper reaches of the watershed. These structures proved to be inadequate and were removed by the first flood after their completion. In 1931 the Government took a hand in helping the Indians construct a dam at this point. It has since been enlarged with Federal assistance. This original dam still stands, although it is rapidly losing its value for stock water due to the large depositions of silt with each runoff.

Beginning in 1935, various conservation agencies, as well as the local school children, carried on a tree-planting program in the Keams Canyon Wash. This project has been continued, during which time thousands of erosion control trees and shrubs, including cottonwood, willow, and Russian olive have been planted. The survival has been very high on these plantings and a rank growth of vegetation is now noticeable throughout. This vegetative growth has been particularly effective in stabilizing the stream bed and preventing further lateral erosion. Several check dams and dikes were strategically placed in the headwaters. These have been helpful in slowing the downstream movement of flood waters.

In 1943 a series of larger structures were placed upstream on the main channel directly above the canyon. All of these structures, with the exception of one masonry dam, are of the earth-filled type. In most cases the fill was placed with bulldozer and carryall and compacted with the aid of a sheeps-foot roller. Locations have been limited somewhat by the absence of adequate spillway sites. In terrain of this character it is preferable to utilize rock outcroppings in order to avoid erosion. Structures were originally designed for erosion control and to provide supplemental livestock water in order to obtain better distribution of livestock and to avoid excessive trailing to permanent watering places.

Two structures, known as Twin Dams, were constructed just above the confluence of the two principal drainages at which point they enter the canyon. Spillways were so designed as to permit flow between basins. This has the advantage of a double impounding area in the event of rain falling in either of the small watersheds —a condition which is not uncommon in this section. In 1947 several heavy downpours occurred over the entire watershed which caused some damage to one of these structures. As a result of the vegetative growth which had been established, very little, if any, erosion took place in

the channel below. The structure was repaired and is now functioning satisfactorily. In 1953 it was noted that a considerable portion of the storage capacity above these structures had been lost due to sediment deposits. The structures subsequently were increased in height. To avoid the development of a permanent storage of relatively shallow water having a large surface area, outlets were provided to draw off a portion of the stored water in a controlled manner.

Land Management Programs Are Effective

In conjunction with the program, livestock numbers utilizing the area were reduced in order to properly graze the available forage. The better forage cover has had a stabilizing effect in the upper reaches of the area by reducing both wind and water movement of the soil. Some range revegetation work with desirable forage species is continuing in isolated areas as is the control of undesirable vegetation, primarily big sage and juniper. Considerable control of juniper remains to be accomplished throughout the area. Approximately 2,000 acres of sage have been eradicated by mechanical means to date. Although the process is slow, a noticeable increase in vegetative cover is in evidence. Range studies in the treated areas have shown that forage production has increased from 204 pounds per acre (dry weight) in 1952 to 356 pounds in 1955.

Stock water reservoirs having a relatively shallow impoundment and a large surface area are being reconstructed to provide deep storage pits with a minimum amount of water surface. The old structure is then utilized as a desilting basin and the excess water bypassed.

Wildlife habitats throughout the canyon have been greatly enhanced. Flow of the once-plentiful springs mentioned in the earlier historical reports had diminished by the late 1930's to the point where their influence on the stream bed was noticeable only a short distance below their emergence. It should be noted at this point that a portion of this decrease was due to a tapping of the spring to increase domestic water supplies at the agency headquarters. This source was rapidly diminished, however, as was the underground water supply at the agency well.

Watershed Resource Management

This is the fifth article in the Journal's special series entitled "Protecting and Developing the Nation's Watersheds." It was prepared by Robert G. Struble of the Brandywine Valley Association, West Chester, Pennsylvania, and A. R. Croft, forester, Intermountain Forest and Range Experiment Station, U. S. Forest Service, Ogden, Utah. The final article in the series will appear in a subsequent issue of the Journal.

In 1951 four beaver were planted in the old channel. Immediately the few small seeps were dammed. In a little more than four years the beaver population has increased to twenty-eight and they have constructed a series of eighteen dams. It is recognized that it will be necessary to control the beaver population to keep it in balance with the available food. Trout planted in 1953 behind some of the beaver dams have thrived and spread throughout the system. Large willows, cottonwoods, and other phreatophytic vegetation have been controlled to a large extent in the upper portion of the canyon by the beaver. Portions of the Wash, dry a few years ago, now have a small permanent flow. Ground water sources are being replenished, as evidenced by an increased amount of domestic water available at the agency. The agency is still confronted with water shortages during certain seasons of the year. There is no attempt in this article to infer that the treatment to date in this relatively small area has solved the problems in its entirety. During the past few years the agency has increased materially in size, thus increasing the demand for water. As time goes by, it is probable that some additional increase in water supply will be noted as a result of treatment within the Keams Canyon watershed. If, in time, more of the area surrounding the canyon is similarly treated perhaps the Keams Canyon water supply will become adequate for all its needs.

The project has served an additional purpose in that it has effectively demonstrated to the Indian people, both young and old, the value of proper land use. Various conservation measures, including erosion-control structures, tree planting, and proper livestock management are becoming common practice on the Hopi Reservation.

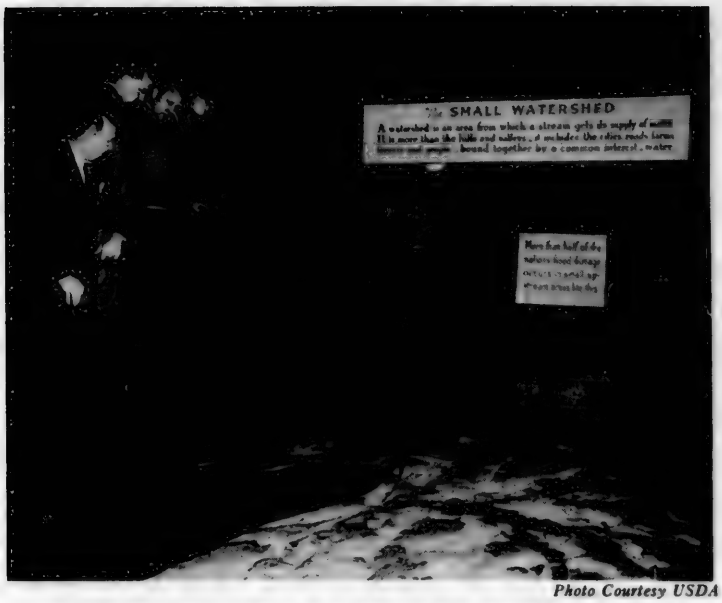


Photo Courtesy USDA

Watershed Resource Management . . .

President Eisenhower looks over a large-scale exhibit in the United States Department of Agriculture patio which illustrates the Department's comprehensive plan for a "dynamic resources conservation program."

No two watersheds in America are exactly alike. They differ in size, topography, climate, soil and water resources, land use and people. Because of these differences, it is impossible to prescribe any single pattern of watershed management that will work for all watersheds or drainage basins. However, several typical watershed programs may suggest guiding principles which will be useful in the management of almost any watershed. Such programs may range in scope from those undertaken by a few neighbors to control the water in their small creek to vast river basin development projects.

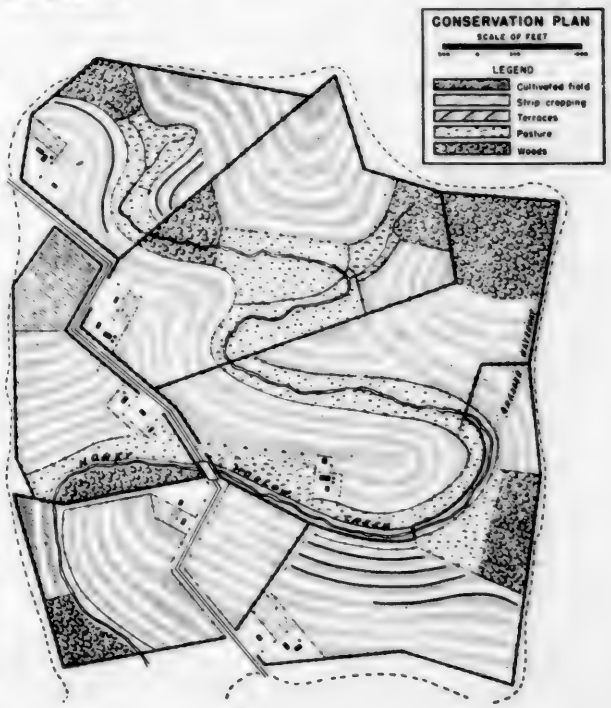
The following examples described in order of increasing complexity represent a cross section of various approaches to watershed management.

Honey Hollow Creek

Made up of six farms, covering about 840 acres, Honey Hollow Creek represents the smallest unit and least complicated form of watershed management. By their own initiative, the farmers owning and living in this small watershed voluntarily established soil and water conservation measures on all their farms within the capabilities of their land.

Contour strips, terraces, sod waterways, good rotations and reforestation have been sufficient to manage the water which formerly caused the creek to overflow its banks. Damage to farm lands in the lower section of the stream has been kept to a minimum.

No organization was formed. Through the leadership of one farmer the transformation took place. The only help they sought was technical assistance. As all big watersheds are nothing more than the sum of a lot of little watersheds, what happened on Honey Hollow Creek could serve as the "first step" pattern for any watershed in America. In fact, just this sort of pattern is being developed in scores of soil conservation districts throughout the Nation.



This map shows how six farmers in the Honey Hollow Creek watershed established soil and water conservation measures on their farms.

Twenty-three farmers in the Stone Valley area, without a formal watershed organization, have developed a satisfactory conservation program.

Photo Courtesy Soil Conservation Service

Stone Valley

Containing 23 farmers and covering over 2,000 acres, Stone Valley in Northumberland County, Pennsylvania, illustrates the larger type of watershed that can be planned without formal organization. Aggressive local leadership, supplied with sufficient technical know-how did the trick.

Application of the same conservation measures as described above, when applied to 90 per cent of the watershed, brought about satisfactory control of erosion and runoff. Soil conservation district directors were largely responsible for bringing about the desired results.

The Brandywine Valley

Where towns and industries are important parts of a watershed, additional requirements are involved in watershed management. The Brandywine Valley Association deals with such a watershed extending from Chester County, Pennsylvania to Wilmington, Delaware.

The 210,000 acres in the Brandywine drainage area include almost every resource problem that exists in a small watershed. Although there are no dams for hydroelectric power (except to run a grist mill) and, as yet, no flood control dams, there is a marine terminal for shipping, industries of many kinds, towns of assorted size, 1,500 farms and 200,000 persons who live, work and play in the Brandywine Valley.

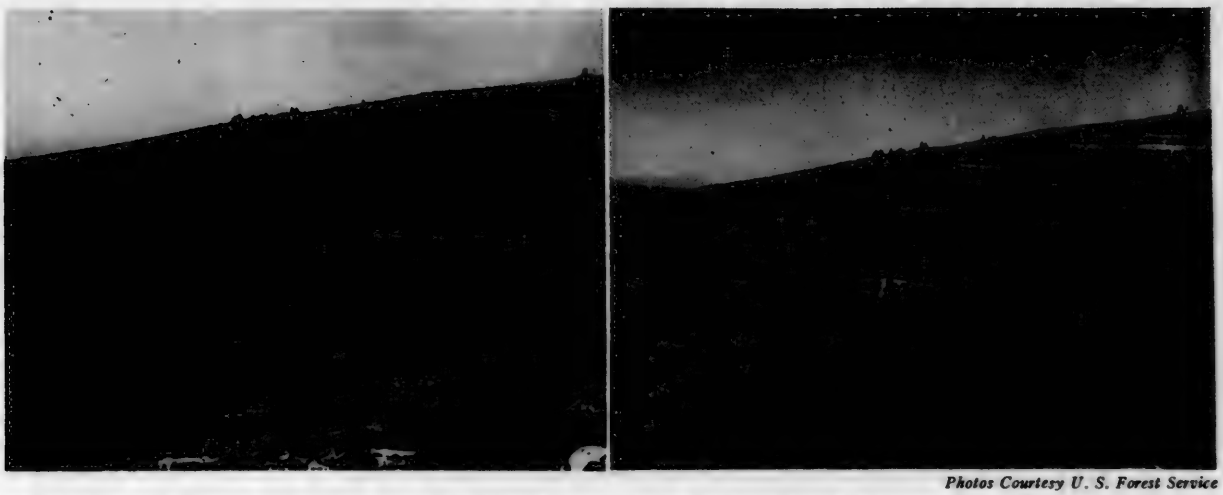
The Brandywine Valley Association, financed completely by membership dues, is currently seeking to accomplish three major objectives in watershed management: *(1) A proper sewage disposal plant for every town, (2) adequate waste treatment plants for every industry, and (3) a complete conservation plan on every farm.* An application has been made by the local soil conservation districts with endorsement by BVA for developing a watershed project under provisions of Public Law 566. The first two objectives of BVA are not covered by authorities of soil conservation districts or Public Law 566, yet their attainment is absolutely essential to the sound development of this watershed.

Voluntary watershed associations are often needed in addition to soil conservation districts. They bring in business, industry and townspeople as natural partners in developing the watershed. The BVA program includes water resource investigations such as a gaging station to determine reduction in silt load and several observation wells to record changes in the underground water level. Recently the Association started a survey of long-range water needs of the Valley. Water storage reservoirs in the headwaters are contemplated by the local people to abate flood damage, increase low flow, provide recreation and additional water for expanding towns, industries and agriculture.

There are no technicians on the BVA staff. Its purpose is to create interest in conservation, urge the people to act,

Rain and flood recording gages are important devices in determining the effectiveness of watershed programs.

Photo Courtesy Soil Conservation Service



Photos Courtesy U. S. Forest Service

These photographs show a seriously eroded and gullied portion of the Pleasant Creek Watershed before and after treatment with special purpose terraces and seeding. The terraces shown at the right were constructed to break up the devastating gully system, store the water where it falls so that it can be put to use in the production of vegetation, re-establish soil stability, eliminate floods and provide a sustained yield of usable water.

then refer them to the proper agencies for assistance. All local, state and Federal agencies qualified to help are cooperating. The Association also urged passage of a clean streams law in Delaware and promoted formation of a soil conservation district in Chester County, Pennsylvania.

Pleasant Creek

The Pleasant Creek Watershed, like most similar watersheds in the Inter-Mountain West under Forest Service administration, is managed for maximum use of all resources. This is commonly called multiple land use management and includes such resources as: Forage for livestock, forage for big game and big game management, timber production, recreation and water. Water, in the arid West, is more valuable than all other watershed resources combined because it supplies the domestic and irrigation needs for the people, and on many areas, such as Pleasant Creek, it is used to generate hydro-electric power for local use.

This watershed has an area of 21,329 acres. National forest lands occupy about one-fourth of the area. The upper three-fourths of the watershed is mountainous with slopes ranging from 10 to 70 per cent.

A watershed plan was developed under the *"pilot watershed"* program for Pleasant Creek with Federal and local interests sharing the costs. The United States Forest Service has carried out the watershed management work including the special-purpose terracing on the higher areas of the watershed, while the Soil Conservation Service has assisted in stock pond development, range land management, channel improvements, and debris basins.

Although the project is not yet completed, a storm in August 1955 proved its value. When the storm struck only about half of the upper watershed had been treated, as planned, with special purpose terraces, reseeding and gully plugs. The special purpose terraces retained water on the land where it fell. In the gullied portions of the watershed, water was quickly funneled to stream channels laden with large quantities of eroded soil, rock and other debris.

Observers described this as follows:

"The debris struck the upper spreading dam and almost immediately dropped its traction load. As quickly as the initial mass was stopped, a chain reaction worked its way upstream. The result was a layer of rock five to eight feet deep deposited for the full width of the channel for a distance of nearly one-half mile upstream."

The town of Pleasant Creek was thus protected from what would have been very severe damages from the debris-laden flood.

Sandstone Creek

As watersheds get bigger and rainfall patterns, soil types and topography more varied, simple conservation measures may not be sufficient to manage the watershed properly. Detention dams are often the next step.

Sandstone Creek in Oklahoma, a tributary of the Washita River, illustrates well this stage of management. This creek drains 65,000 acres in the Rolling Red Plains area. Seventy-two per cent of all the flood damage in the Washita occurs along the small tributaries. The Washita River watershed, of which Sandstone Creek is a part, was one of eleven watersheds in the United States authorized for runoff retardation and soil erosion control by the Department of Agriculture in the Flood Control Act of 1944. About 95 per cent of the land-treatment measures in the Sandstone Creek watershed have been applied

The Muskingum Conservancy District was originally established for flood control. It now encompasses conservation farming, water management, forestry and recreation.

Photo Courtesy Soil Conservation Service

through local soil conservation districts. While these have been effective in reducing erosion and rapid runoff, other measures were needed to reduce flood damage to agricultural land.

The Soil Conservation Service designed and supervised construction of a system of 24 floodwater-retarding structures at strategic locations in the watershed. These small upstream dams cost an average of about $50,000. Soil conservation districts agree to maintain the dams.

Detention dams are designed to hold at least the maximum runoff, three to five inches, to be expected once in 25 years. Flood storage capacities range from 78 to 2,750 acre feet. Floodwaters are released slowly through automatic draw-down tubes, thus minimizing overflow of bottom land. The area flooded behind any one dam is so small that it seldom constitutes a serious loss to the farm or community in which it is located.

The Muskingum

A larger scale and older development on the pattern of Sandstone Creek may be found in the Muskingum River watershed in Ohio. The Muskingum Conservancy District created in 1933 deals with a watershed of over 5,000,000 acres. Established originally for flood control, the comprehensive district plan now includes: *(1) promotion of conservation farming, (2) sound forestry practices, (3) recreation, and (4) flood control.*

The original nucleus of the watershed project is a series of 14 flood control and water storage reservoirs on tributary headwaters of the Muskingum River. The capacity of the reservoirs is 1,539,200 acre feet, of which 1,326,400 acre feet are reserved entirely for flood control and the remaining 212,800 acre feet for conservation and recreation. The lakes provide a recreational program that is estimated to be worth $800,000 annually.

At its inception, the Muskingum plan was considered a radical departure from the "big dam on the main river" idea. The soundness of this bold new concept has long been proved by reduced flood damage, improved recreational facilities, reduction in land lost by inundation and increased income to the area. The Muskingum Conservancy District has been regarded by many as a model for watershed development as applied to larger rivers.

The Tennessee Valley Authority

The TVA represents a type of watershed development combining large dams for flood control, navigation and power production. This Authority type of watershed management is heavily financed by Federal funds and is therefore subject to Federal control.

Demonstration or pilot farms have been used by TVA to interest local landowners in soil and water conservation. Considerable research has also been done in cooperation with State and local agencies to improve the agriculture of the area.

Wisconsin Valley Improvement Company

In almost direct contrast to TVA, the Wisconsin Valley Improvement Company has used private capital almost entirely to develop the Wisconsin River. Dams have been built to reduce floods, improve low flow and generate power. Main function of the WVIC has been to develop the river itself, with little or no concern for the watershed which feeds it. There are some indications that the Company may expand its activities to encourage proper land use practices.

Obviously, only a very few examples of watershed restoration through the cooperative efforts of all people concerned have been described. A great deal more remains to be done throughout the entire country. This problem presents a challenge to the know how and the ability of people to work together for the common good. Watershed restoration and management is the business of everyone: The banker, businessman, farmer, manufacturer, and of citizens generally. All have a stake in good watershed resource management, because in some way it affects their everyday life and welfare, socially and economically.

Soils and Watershed Protection

G. W. MUSGRAVE

One of the several ways of increasing the efficiency of watershed planning—a subject that has been and is now receiving intense study—is by grouping soils according to response under intense rainfall.

PROTECTION OF WATERSHEDS against the damage caused by excessive runoff requires all the skill, and application of all the information, that can be mustered by those concerned with the design of control measures. A problem always encountered is that of evaluating the soil in terms of hydrologic performance.

As everyone knows, runoff is greater from tight clays than from deep, permeable sands. In between these extremes there are all gradations of soils and of runoffs—even where rainfall and vegetation are similar. Soils vary in the amount of intake of rain or snowmelt because they vary in their physical properties—some being predominantly of sand, others of clay; some having a deep, permeable layer at the surface, others being shallow; some swelling greatly when wet, others very little. These and other properties have profound effects upon both the rate and amount of intake of water.

Methods of Measuring Rates of Intake

Formerly, rates of intake on the different soils of watersheds were measured on small sample areas located strategically throughout each area. Many different methods of doing this have been devised and used and they have proved satisfactory for showing which soils had high and which low intake rates. The methods were also useful in showing the *relative* effects of different kinds of vegetation on intake of water. But in looking back on this early work it is now apparent that these methods did not tell us *how much* was the intake on the same broad areas in which the samples were located. ***Whatever were the methods of testing on the small areas, the results were nearly always larger than those indicated by the watershed itself. To a considerable degree the results were characteristic of the method used.***

For example, on very small test areas the intake rates were higher than those derived from areas of greater size even when there were wetted exteriors in both cases. It was found that artificially-applied rainfall through nozzles that produced a small size or mist type of raindrop gave higher intake rates than those from a nozzle that produced a larger raindrop size. Furthermore, the relative differences between different kinds of equipment or method of test varied with different vegetation and watershed condition, showing that any conversion factor intended to change one set of results to the equivalent of those of another method was impracticable. And because large numbers of tests were necessary in any watershed, the costs involved in this procedure were high. ***For all of these reasons—and some others as well—it is clear that we need other and more efficient and expeditious methods of evaluating soils hydrologically.***

One thing not utilized fully in this early work was the

G. W. Musgrave, an active member of the SCSA, is staff specialist on infiltration, Division of Engineering, Soil Conservation Service, Washington, D. C.

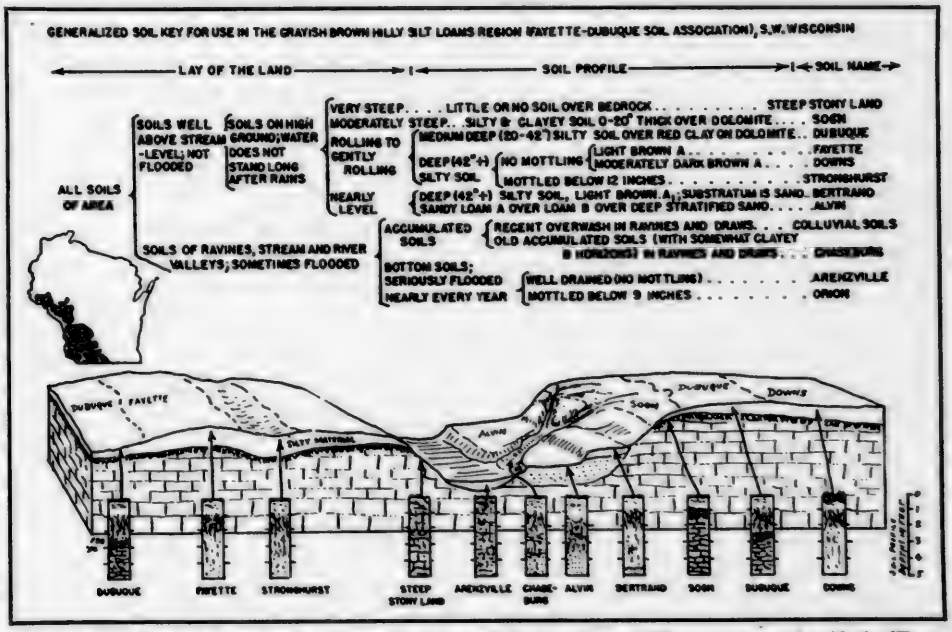

GENERALIZED SOIL KEY FOR USE IN THE GRAYISH BROWN HILLY SILT LOAMS REGION (FAYETTE-DUBUQUE SOIL ASSOCIATION), S.W. WISCONSIN
LAY OF THE LAND
SOIL PROFILE
SOIL NAME
ALL SOILS OF AREA
SOILS WELL ABOVE STREAM -LEVEL; NOT FLOODED
SOILS ON HIGH GROUND; WATER DOES NOT STAND LONG AFTER RAINS
VERY STEEP . . . LITTLE OR NO SOIL OVER BEDROCK . . . STEEP STONY LAND
MODERATELY STEEP . . . SILTY & CLAYEY SOIL 0-20" THICK OVER DOLOMITE . . . SOGN
ROLLING TO GENTLY ROLLING
MEDIUM DEEP (20-42") SILTY SOIL OVER RED CLAY OR DOLOMITE . . DUBUQUE
DEEP (42"+) SILTY SOIL
NO MOTTLING
LIGHT BROWN A . . . FAYETTE
MODERATELY DARK BROWN A . . . DOWNS
MOTTLED BELOW 12 INCHES . . . STRONGHURST
NEARLY LEVEL
DEEP (42"+) SILTY SOIL, LIGHT BROWN A; SUBSTRATUM IS SAND . BERTRAND
SANDY LOAM A OVER LOAM B OVER DEEP STRATIFIED SAND . . . ALVIN
SOILS OF RAVINES, STREAM AND RIVER VALLEYS; SOMETIMES FLOODED
ACCUMULATED SOILS
RECENT OVERWASH IN RAVINES AND DRAWS . . . COLLUVIAL SOILS
OLD ACCUMULATED SOILS (WITH SOMEWHAT CLAYEY B HORIZONS) IN RAVINES AND DRAWS . . . CHASEBURG
BOTTOM SOILS; SERIOUSLY FLOODED NEARLY EVERY YEAR
WELL DRAINED (NO MOTTLING) . . . ARENZVILLE
MOTTLED BELOW 9 INCHES . . . ORION
DUBUQUE
FAYETTE
STRONGHURST
STEEP STONY LAND
ARENZVILLE
CHASE-BURG
ALVIN
BERTRAND
SOGN
DUBUQUE
DOWNS

Figure 1. This is an example of how certain soils in southwest Wisconsin are classified. (From *"Introduction to the Soils of Wisconsin,"* by FRANCIS D. HOLE AND GERHARD B. LEE, *Univ. of Wisc. Bull. 79, 1955, p. 26.)*

existing knowledge of the physical properties of the different soils and their profile characteristics. Soil scientists specialize in this kind of information. They know the usual thickness of soil horizons and how they vary with topography. They know the texture of the different horizons, whether or not the soil swells appreciably when wet, and many other characteristics important to their hydrologic behavior—particularly their response to extended rainfall or other application of water. They have detailed descriptions of most of the major soils of the country. Both in the State and Federal service there are soil scientists who are intimately acquainted with the soils of the area in which they work. Clearly this is information of great value to those concerned with watershed protective measures.

Figure 1 shows the relationship of some of the major soils in a landscape common to southwest Wisconsin (1). This is an area where silt loams predominate and therefore one with generally little difference in texture of the soil surface. However, many of these soils do differ in depth or thickness of soil material to hard rock, and, of course, in topography. As may be seen from the diagram, Sogn is a relatively shallow soil over limestone and therefore has a very limited capacity for receiving water. The Fayette is a much deeper soil, with a greater capacity, and ranks higher in the soils array.

The deep sands of high intake at the high end of the scale and the extremely tight clays at the low end of the scale of intake are not represented in this section. In many landscapes, of course, these soils may occur in either the upland or bottomland position. Soils of intermediate intake rates (such as the Sogn and the Fayette) are of more common occurrence than those of either the extremely high or extremely low rates.

When we consider the thousands of soils in the country and their many variations in texture, depth, and obvious differences in intake potentialities, we can visualize the essentially continuous array in physical properties they form. From the very tight clays with near-zero intake when wet and swollen, the range extends to the deep, open sands with intake rates much higher than normal rainfall rates. On these, of course, runoff rarely occurs.

Determining Rainfall and Runoff Relations

Hydrologists have determined the rainfall and runoff relations on a number of major soils. Through hydrograph analysis they are able to evaluate these soils on an areal basis. They know the profound effect of antecedent rain on certain clays and its much lesser effect on deep sands. This and much additional information is continuing to develop as watershed protection work expands. It needs to be supplemented by the existing knowledge of soil profile characteristics possessed by soil scientists.

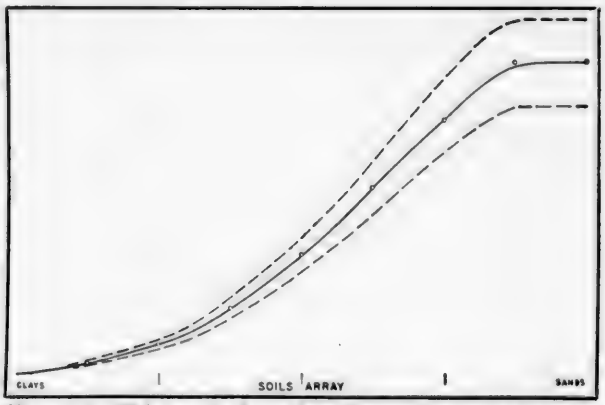


Figure 2. This graph shows how the minimum intake rates (f_c) gradually increase as the soils array progresses from tight clays to deep, open sands.

The hydrologist has a symbol (f_c) for the minimum rate of intake for a soil, such as occurs after prior wetting and at the end of long-duration storms. This is the rate that is particularly important in the design of structures and other control measures. He knows within reasonable limits the relation that exists, for example, between rainfall and runoff on tight clays, the shallow sandy loams, the deep sandy loams, and the very deep, open sands (on which runoff rarely occurs). In Figure 2 is a curve showing how f_c values for such an array of soils gradually rise from a low point in saturated tight clays to a maximum in deep, open sands.

The hydrologist already has considerable data coming from measurements of rainfall and runoff on various watersheds. The soils on these watersheds are known. The position of the soils in the array of major United States soils is known closely enough to establish a point on the curve well within the permissible range (shown by dashed line in Figure 2). Indeed some soils (such, for example, as the Houston clay) have minimum rates known from other data (in this case the f_c is 0.01 to 0.05 inch per hour).

These minimum intake rates, it should be emphasized, are for soils after prior wetting, long-duration storms, and without benefit of the protective effects of vegetation. Such effects are evaluated separately from the soil grouping. It may be expected that shortly many more hydrologic records from other soils will have been obtained. Those from subwatersheds having homogeneous conditions will be of special value. Already a number of points on the curve of Figure 2 are known. The position of the curve can be fixed within reasonable limits with but a few known points.

To some, limits of ±25 per cent (the permissible range

(*Continued on page 129*)

Obstacles to Soil Conservation

PAUL J. ZWERMAN AND JULIAN PRUNDEANU

Farmer investment of time and money in modern soil conservation practice will take place only if the farmer is convinced of the necessity for the practice. He must, as the authors point out in this article, understand the reasons for the recommendations and the soundness of the investment.

THOUSANDS OF FARMERS and soil conservationists are working together toward improved soil and water conservation. However, many obstacles exist that must be overcome (2, 3). Few attempts have been made to study the attitudes and understanding of the farmer as a factor in overcoming these obstacles and achieving this goal of soil and water conservation.

The work reported here is a portion of a larger study to find possible reasons for farmer acceptance or non-acceptance of soil conservation. *Two methods were used. One consisted of the study of data accumulated in the soil conservation district farm plans. The second method used was of an intensive study and interview with a small selected group of farmers.*

District Records Determine Farmer Attitudes Toward Conservation Practices

The personnel of the U. S. Soil Conservation Service gave generously of their time and advice in assisting in a detailed examination of the farm plans developed during the years 1946-48 in three central New York counties. In the Ontario County Soil Conservation District 55 farm plans were available which contained complete recommendations of the soil conservationist at the time the plans were developed. These plans also contained statements of the district cooperator as to his extent of agreement with the recommendations of the planning soil conservationist. Examination of the records early in 1953 made it possible to compare cooperator achievement on a range of practices after an average time of five years.

Practices were grouped into three types which, for lack of a better classification, are called A, B, and C.

"A" practices were those which required little or no annual effort or maintenance on the part of the cooperator once established. They permitted normal or customary operation of the prevailing farm practices. They were: tile drainage, tree planting, wildlife area improvement, and stream channel improvement.

"B" practices were those which required a moderate amount of annual effort or maintenance on the part of the cooperator once established. They interfered with normal or customary farm operation of prevailing farm practices to a moderate degree. These practices were: perennial hay, woodlot management, woodland protection, farm structures, open drainage, outlets and farm water courses, and farm ponds.

"C" practices were those which required a fairly high amount of annual effort or maintenance. They interfered markedly with the normal or customary farm operation of prevailing farm practices. They were: pasture management, pasture improvement, contour farming, permanent fence, clearing and obstruction removal, strip cropping, crop rotation, cover cropping, pasture seeding, and field diversions.

If one uses the recommendations of the planning soil conservationist as a standard of 100 per cent throughout, it is very evident from Table 1 that there is a progressive decline in agreement with planning recommendations as one goes from types of practices A through C. There was even a greater decline in establishment calculated on the same base. That is, agreements were easily forgotten in the group C practices when the cooperator was faced with an annual chore as well as a change in his customary way of farming.

Table 1: Influence of type of soil conservation practices on agreement and establishment by cooperator.

Type of practice	Recommended by planner	Agreed with by cooperator	Established by cooperator
	Per cent	*Per cent*	*Per cent*
A	100	94	96
B	100	79	66
C	100	56	30

Interviews Help Gain a Better Understanding

Two groups of farmers were selected on the basis of their degree of establishing recommended soil and water conservation practices. Both of these groups of farmers were in Cayuga County, one of the three counties under intensive study. All of the farmers were owner operators. All were district cooperators. One group of farmers which we will call the high group established a comparatively larger per cent of practices than 15 farmers in the low group. A practice was considered established when it was 75 per cent complete. All 30 farmers were subjected to an intensive interview (see figure 1) to determine the reasons for the differences in establishing practices (4).

The results of the interviews substantiated the results

Paul J. Zwerman, a member of the SCSA, is associate professor of Soil Conservation. Julian Prundeanu is associate professor of Agronomy, National Agricultural College, Doylestown, Pennsylvania. This paper is a portion of a thesis submitted to the graduate faculty of Cornell University for the degree of Doctor of Philosophy by the junior author.

of the examination of the farm plans in adjacent Ontario County. All farmers reacted to a varying degree against annual upkeep and interference with normal farm operation. However, in type A practice the high group used five per cent more practices than the low group. For types B and C they used 50 and 20 per cent more, respectively, than did the low group.

The economic differences between the two groups are brought out in Table 2. In looking over Table 2 it is apparent that no clear-cut economic reason could be found for differences in acceptance of practices. Capital investments were not shown on the table because both were very similar as was also the value of land, buildings, livestock, and equipment. Because the acreage of land in the high group was small, the per-acre value of the land was higher. Another factor that worked toward a higher per-acre value in the high group was the comparatively low acreage of woodland and permanent pasture.

Photo by Department of Visual Aids, Cornell University, Ithaca, N. Y.

Figure 1. Intensive interview in progress. Farmers freely expressed their views on various soil and water conservation practices.

Table 2: Economic comparisons of mean values for high and low conservation farms in Cayuga County subsample.

Economic characteristic	High group	Low group	Difference
Acres owned and operated	197	296	—99
Acres of cropland	153	215	—62
Acres of land in permanent pasture	16	24	— 8
Acres of woodland	8	37	—29
Number of dairy cows	10	20	—10
Number of hens	496	141	+355
Productive man work units	411	536	—125
Soil Conservation incentive payment—annual	$88	$75	+$13

Although it might be assumed that the high group of farmers had more time to do their work and improve their land with soil conservation practices, there was no difference between the two groups in custom work hired or in work off the farm.

Differences in Understanding and Attitude of Farmers—Key to Acceptance

The intensive interview brought out some marked differences in farmer attitude. These differences are shown in Table 3. During the period of the intensive interview, questions were asked on a variety of subjects to learn more about the educational and social background. An attempt was also made to appraise the farmer's attitude toward soil conservation. No difference between groups could be observed in schools attended, farm organizations, or participation in farm programs. There were no differences in purchases of certified seed or on ideas of tillage.

When future farm plans were discussed with farmers they invariably rated building improvement, buying equipment, increasing livestock, and buying land above additional soil conservation improvements. This same situation held true when they were given a hypothetical sum of money equal to 20 per cent of their total capitalization.

This last device of giving the farmer hypothetical sums of money was most revealing when it was followed through to learn what types of practices would be used to bring about soil conservation improvements. Both groups would use practically all type A practices—almost exclusively tile drainage. The general reaction of both groups was uniformly against type C practices. *Not a single farmer interviewed liked contour cropping. Most frequent objections from both groups were: "not needed on this farm," "short and crooked rows," "difficult to work and operate machinery," and "requires relocation of fences." Very similar objections were raised against contour strip cropping and terraces. Clearing land was not objected to so vigorously. Lack of time and capital were the chief objections. The general objections given to a longer crop rotation were too much hay and lack of cropland. Other type C practices had only minor objections.*

In general there was little interest in both groups in the woodland improvement practices listed under type B. Major interest centered around open drainage. The main-

Table 3: Difference between groups of farmers in the high and low conservation groups.

Characteristic or management feature	High group	Low group
	Per cent	*Per cent*
Keeps farm records	60	40
Partnership	40	13
Bought seeds in advance	67	46
Definite ideas on use of farm manure	40	6
Sought advice of planner	60	33
Thought soil conservation very important	67	40
Unwilling to pay for soil conservation at commercial rate	33	70

ever, 70 per cent of the high group was convinced that open drainage was necessary and that they could not do without it. Only 12 per cent of the low group was so convinced. One-third of the low group regarded open ditches as a waste of land.

In discussing needs of the various practices, the district cooperators repeatedly expressed the view that their farms were not subject to erosion. They associated erosion with steep slopes and gully formations. Sheet erosion was generally overlooked and not understood by all farmers. tenance problem was objected to by both groups. *Drainage practices were considered to be soil conservation. Mention was frequently made of the fact that type C practices were not necessary because there was no soil erosion on "this farm." This observation is contrary to conservation survey data and measured soil losses (1, 5).*

It should also be noted that no good correlation could be found between the physical features of the land and particular soil conservation practices established. Because of the similar economic conditions noted above, the attitude of the individual farmer must be considered as an important factor in establishing the recommended soil conservation practices.

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Soils and Watershed Protection

(*Continued from page* 126)

shown by the dashed line of Figure 2) may appear too wide, but when one realizes that rainfall, runoff, and other required data for a watershed evaluation are not precise at present, it is clear that any greater precision in soil evaluation is not demanded.

The Four Hydrologic Soil Groups

In the hydrologic evaluation of watersheds the Soil Conservation Service utilizes four hydrologic soil groups. *In Group A are the deep, highly permeable sands and loamy sands. At the other end of the scale, in Group D, are the tight clays. The soils in between these groups are Group B (above-average f_c but below the maximum Group A) and Group C (below-average f_c but above the minimum Group D).* Actually, soil scientists are able to subdivide to a much further degree than this and have done so in numerous instances. This refinement can be incorporated when the refinement of related needed data materializes.

In all probability we shall never include all soils in the grouping. The engineers concerned with watershed protection can readily consult with a local or state soil scientist and determine the soil group or groups in any particular watershed. By comparison with the soils that have been listed and grouped, any new ones can be assigned to their correct hydrologic groups.

Much remains to be done, both by soil scientists and hydrologists, and indeed work is already in progress on most of the following:

1. accumulation of hydrologic data on more key soils;
2. accumulation of physical data (especially kind of clay minerals, degree of swelling, relative aggregability, total and available water capacities) of typical soils;
3. rechecking and refinement of the hydrologic groups, particularly for the soils that may be regarded as borderline;
4. continuing research on physical properties of soils as they relate especially to the movement of water into and through them.

However, we have here a method of evaluating expeditiously the hydrologic features of soils that may be found in a watershed. It is a method more realistic than the old infiltrometer surveys. It utilizes the extensive and detailed knowledge of both the soil scientists and the hydrologists. It is a basic method on which we can build as more and better information becomes available.

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The Sense of Using Dollars in Soil Conservation

ELMER L. SAUER

Elmer L. Sauer

Secretary of Agriculture Benson, in an article in the May 1954 issue of the Journal of Soil and Water Conservation, said, "The soil, water, range, and forest resources of the United States are the natural foundation of our national economy. From them come our food, most of our clothing, and much of our shelter. How well we protect and improve these resources will have a direct bearing on the future standards of living of the whole nation."

MANY FARMERS, LANDOWNERS, and others recognize the need for soil conservation. However, they may have questions as to whether the benefits equal the costs, how to obtain enough capital to finance a conservation program, how to forego current income to increase future income, and others. Often farmers on small and/or badly depleted and eroded farms cannot meet adequately from current income both family living and land-improvement costs.

An individual farmer must consider current returns on his investment as well as the longer time problem of maintaining and improving the productivity of his farm. The consensus on the 1956 farm outlook is that production is likely to remain near current levels while marketing charges are likely to average higher than current levels. With little change in prices, there may be some decline in net farm incomes. To meet this cost-income squeeze, should farmers reduce their expenditures for conservation?

Answers to some of these questions on the economic feasibility of soil and water conservation are being obtained by the Agricultural Research Service, United States Department of Agriculture, in cooperation with state agricultural experiment stations. Such studies have been carried on in Illinois since 1936.

These studies definitely indicate that a farmer should not reduce his expenditures for conservation, if he is not operating now at a high level of conservation. The old saying, "It takes money to make money," is true for conservation and land improvement. A farmer with efficient, high-volume production from the resources at his disposal will deal most effectively with the cost-price squeeze. To a point, high per acre yields help to reduce production costs per bushel and per ton. Enough well-managed livestock to utilize the forages produced under the conservation plan will help to increase the volume of farm output. Using dollars to apply conservation and related farm improvements increases net farm income by (1) increasing yields and grain and forage production and (2) more livestock making it possible to use labor and other resources most efficiently.

Capital Investments Increase Farm Income

The family farm business is becoming larger with the economy of the nation. To be successful, a family farm must have a business large enough to justify the capital investment required by modern farm technology. The 1954 Illinois farm account records shows that 945 family-sized farms in the northern two-thirds of the state averaged 183 acres in size, had a total farm investment of $81,830 per farm, and used 15.9 months of labor of which 2.5 was hired. The investment per worker varied from $40,800 for dairy farms with lower soil ratings to $82,800 for 180- to 259-acre grain farms on good soils, and averaged $61,700 per worker for the 945 farms.

Successful Illinois farmers have increased their volume of business and thus the effective size of their farms by using more capital. In 1954, account-keeping grain farms had average soil fertility costs of $4.16 to $7.44 per tillable acre. This cost was approximately twice as much as was spent on the average Illinois grain farm. But yields on these accounting farms were approximately 30 per cent above those on the average grain farm. In 1955 a random sample of cash-grain farms following recommended soil conservation practices spent about 50 per cent more for fertilizer and land improvements than farms of similar soil resources not following a recommended conservation program. Returns were $32 an acre for the conservation farms compared to $23 an acre for the others.

Elmer L. Sauer, agricultural economist, Production Economics Research Branch, Agricultural Research Service, United States Department of Agriculture and a member of the SCSA, presented this paper before Farm and Home Week, College of Agriculture, University of Illinois, Urbana, Illinois, February 1, 1956. Mr. Sauer is also a member of the Editorial Board of the JOURNAL OF SOIL AND WATER CONSERVATION.

During the past two years high-conservation farms in the northeastern Illinois slowly permeable soils area earned by soil groups $3.09 to $7.64 more per acre than physically comparable low-conservation farms. Total capital expenses for conservation and related improvements were about twice as great on the high-conservation as on the physically comparable low-conservation farms. Land improvements and fertilizer expenditures have more than doubled on high-conservation farms in the northeastern Illinois area in the past five years indicating that these farmers are convinced such investments do pay.

Although more conservation may boost total expenses, returns from additional farm production are usually large enough to more than off-set the added cost. The economic use of capital must be determined on an individual farm basis. More and better management is needed along with the use of more capital on the farm.

If his capital is limited, a farmer will usually find it most economic to reduce first expenditures for those items that do not affect immediate crop yields.

In 1954, in the Hadley Creek pilot demonstration watershed in western Illinois, farms of similar land-use capabilities had yields of corn that varied from 23 to 63 bushels per acre and net income that varied from –$11.25 per acre to $25.00 per acre. Expenditures for conservation and fertility improvement varied from zero to $15.77 per acre. Taxes, interest, land preparation and, to a certain extent, seed, machinery and labor costs were about the same on the high-producing as on the low-producing farms.

Earnings Are Reflected in Land Use Programs

The Hadley Creek watershed farmers whose production and earnings were high followed a sound land-use and fertility plan and did an efficient job with enough livestock to have a good volume of business. Most of these farmers either had soil and water conservation plans in operation or were developing them. The higher earning farmers had well-established conservation plans that include a land-use program that fits the capabilities of the land; followed a sound crop rotation; used contouring, terraces and grassed waterways; applied limestone, phosphate, and potash according to soil tests; and used mixed fertilizers and straight materials for current crops. These farmers also follow a well-developed, efficient livestock program. In this area, as in others, both landlords and tenants stand to gain by shifting to conservation systems of farming.

Generally speaking, rotations that yield the highest total amount of grain per 100 acres of cropland, within allowable soil loss limitations, will give the highest gross returns. Investments in practices such as terraces, grassed waterways, diversions, contouring, and structures enable farmers to control erosion and to use rotations having higher proportions of grain to forage.

Farmers usually make conservation adjustments in relation to their profitableness. Adjustments in land use from grain to forage crops have been slow because, at least in part, the efficiency of hay and pasture production has not kept pace with the phenomenal rise in production efficiency of grain crops.

Farmers' records substantiate experimental studies showing that erosion losses are reduced by improving the soil with a well-balanced fertility program. High yields of crops produce more organic matter than low yields, thus increasing the ability of the soil to absorb water and retard erosion.

Level-land farmers find that a sound soil and water conservation program for their farm will (1) improve and maintain soil fertility, soil tilth, drainage and water-holding capacity of the soil—in short, the physical resources needed for high crop yields and (2) increases farm earnings, improve or maintain the capital resources of the farm, and help improve farm family living.

Farmers on sloping land can choose between two methods of erosion control: (1) keep a high proportion of land in hay and pasture crops and (2) use terraces, strip-cropping, contouring and other conservation practices with a lower proportion of land in hay and pasture. Livestock farmers may choose the first alternative because they have a market for their forage crops but grain farmers should rely on terracing, contouring and other conservation practices as much as possible. A 1954 study showed that contour farming might increase returns $5.45 per acre by allowing a more intensive rotation while holding soil losses to a minimum. Strip-cropping would increase returns by $6.66 and terracing by $10 per acre.

A ten-year study in three Illinois areas shows that an investment of $25 to $60 an acre in conservation often results in an extra $1,000 profit each year from a 160-acre farm.

High-conservation farmers manage their farm businesses more efficiently than the low-conservation farmers. They make better use of their capital than the low-conservation farmers both for conservation and for increased production. They increase their livestock returns by making economic uses of forages produced under the conservation program.

Long-time benefits of conservation were significant in each Illinois area studied. Such practices as contouring and fertilizing ordinarily increase production and income the first year. Badly eroded and depleted land, however, requires considerable effort, money, and time to build up productivity and earning power.

Changes in income varied with the condition of the farm when the program started, the speed at which the program was applied, the kinds and quantities of fertilizers used, the weather, and the management of the owner

(*Continued on page* 140)

Factors Affecting Runoff from Forest Land Under Extreme Climatic Conditions

GILBERT L. VARNEY

Two hurricane storms crossing the Northeast during August 1955 provided an extensive test of the effectiveness of various types of land use for handling extremely heavy precipitation. As much as 25 inches of precipitation fell on some areas within a week and caused record-breaking floods in many watersheds. Since forest cover occupied approximately half of the land surface, an opportunity was provided, particularly to observe how the forested areas behaved under these extraordinary climatic conditions.

FIELD INVESTIGATION indicated that forest land, even that in relatively poor hydrologic condition, was more effective than other forms of land use in retarding the movement of precipitation to stream channels. However, runoff and sediment contributions from forest land were greater than they would have been if the land had been more consciously managed to protect watershed values. Abandoned logging roads, improperly located, poorly drained, and inadequately stabilized after use, became rushing torrents depositing large amounts of water and sediment in stream channels. Also areas improperly cut, as well as grazed forest and burned-over areas, contributed both runoff and sediment to flood peaks at a higher rate than did areas where these poor practices had not been applied. It was also apparent that factors such as the failure of certain physical improvements directly influenced the timing and height of flood peaks in some watersheds.

Two Storms Affect Entire Northeast

It will be recalled that two storms of hurricane proportions, following one after the other within a week, combined to produce one of the most serious flood situations ever recorded in the northeast. The first storm, "Connie," on August 12-14 deposited from three to eight inches of precipitation and filled most of the available storage space in the soil profile. It raised stream and lake levels well above normal. Consequently, there was little storage space available for the precipitation from storm "Diane" arriving on August 18-19. This storm dropped from three to 16 inches of rainfall. Some indication of the intensity and duration of the rainfall from Diane is available from records maintained at Windsor Locks, Connecticut, where slightly over 12 inches fell between 10:00 a.m. August 18 and 9:00 a.m. August 19. The combination of heavy rainfall and saturated watersheds produced record breaking flood flows, serious property damage, and heavy loss of life.

Specific areas of heavy precipitation and serious flooding occurred on the Upper Delaware River in Pennsylvania and New York; on the Delaware tributaries in New Jersey; on the Naugatuck, Housatonic, and Upper Thames watersheds in Connecticut; on the Connecticut River and tributaries along and below the Massachusetts-Connecticut border; and on the suburban area south and west of Boston extending into the Woonsocket and Providence areas in Rhode Island. A wide variety of land use and cover conditions existed over these areas. Only a few flood control structures had been installed to provide local protection for specific damage centers. Thus, the principal controlling influence generally affecting the timing and height of flood peaks was the land.

Examinations were made of the behavior of forest land during the storm period in those locations where manpower was available. Follow-up examinations were made as soon as possible on other locations while most of the evidence of what had occurred was still available.

In order to secure as complete a picture as possible of the behavior of forest land under extreme storm conditions within the time available, a short field study was made of the Brodhead Creek watershed in Pennsylvania. A more general study was made of the Pocono Region in Pennsylvania and of the Massachusetts-Connecticut watersheds. The area studied received maximum precipitation from both storms, varied widely in land use patterns, and was severly damaged by floodwaters.

The Land-Use Pattern

Approximately 50 per cent of the land surface in the general storm area was in forest cover. Farm crop and pastureland, urban and industrial areas, road and railroad rights-of-way, and idle land made up the remainder. Although forest use was predominant, the percentage of forest land in individual watersheds ranged from as low as 20 per cent to as high as 90 per cent. Variations also occurred within watersheds where the headwaters were nearly all forest cover and downstream areas almost completely agricultural. The combination of variations in land use, in antecedent conditions, and in duration and intensity of storm precipitation make it difficult, without intensive study and analysis, to draw other than general conclusions on the effect of any specific form of land use on the timing and height of flood peaks. Such general conclusions, while true for large areas, may not be entirely applicable on individual small watersheds.

Gilbert L. Varney is a forester in the Watershed Management Unit of the United States Forest Service, Upper Darby, Pennsylvania.

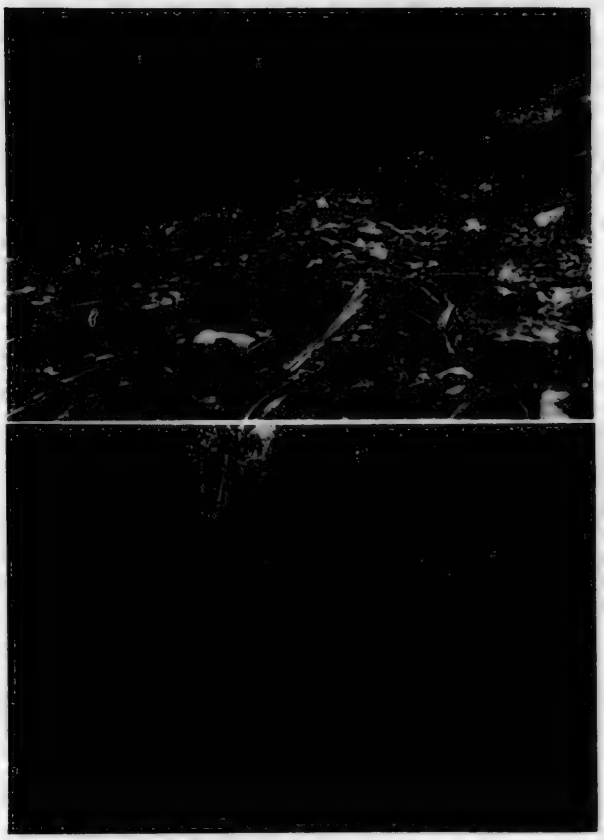


Figure 1. *Top:* This is an abandoned logging road. Failure to provide cross-drainage permitted the old roadway to become a wet-weather-channel, causing serious erosion and creating a condition which will grow increasingly worse unless corrected. *Bottom:* An abandoned logging road, properly stabilized and adequately drained, which did not contribute excessive run-off and sediment to flood flows. Compare with Fig. 1.

Brodhead Creek Watershed. Brodhead Creek, draining approximately 285 square miles, heads up against the Pocono Mountains at elevations ranging from 1,500 to 2,500 feet above sea level. The stream drops nearly 2,000 feet while moving in a southerly direction about 25 miles to the Delaware Water Gap where it enters the Delaware River. The headwaters of the main stream and Paradise Creek, a major tributary, contain a highly developed recreational area based on hotels, summer residences, and young people's camps. This portion is also characterized by the occurrence of numerous small lakes, generally artificially constructed, to provide water recreation for the summer visitors. None of these structures provided any particular flood control benefits and most of them were not designed, constructed, or maintained to withstand a storm of the magnitude of Diane, especially when such a storm followed a period of heavy rainfall which filled all streams and lakes.

Approximately 80 per cent of the watershed is in forest or brush cover. Most of this is in the headwaters. Scrub oak type is found on the extensive heavily burned upper slopes and ridges. Commercial forest types vary from mixed oaks at the lower elevations to northern hardwoods and hemlock on the higher slopes. Stands are mostly in the sprout growth pole and sapling class with average diameters ranging from two to eight inches. Small areas adjacent to recreational developments support good sawtimber stands. Present forest conditions are the result of the heavy cutting carried on from 15 to 50 years ago and often followed by repeated forest fires. There has been little cutting in the past 15 years and improved fire control has reduced the number of fires and area burned over. The present forest, while providing a reasonably adequate cover, is quite young. It has not yet developed the good forest litter and humus conditions needed to provide good hydrologic conditions and insure optimum entry of precipitation into the soil.

Field examination of the forest land indicated that there had been a minimum of overland flow in the forested areas. Signs of overland flow were found only on steep slopes (usually over 50 per cent) and generally with a poorer than average forest cover.

Numerous old logging roads, abandoned township roads, and both paved and unpaved recreational roads traverse the forest area. The percentage of total forest area covered by abandoned and active roads is exceptionally high. These roads, generally lacking vegetative cover and often cutting through the soil mantle, acted to concentrate both surface water and subsurface runoff and served as wet weather channels. Lack of drainage facilities to remove this concentrated water from unstabilized road surfaces and side ditches permitted the development of high water velocities and started erosive action. Wherever these roads crossed stream channels they deposited varying amounts of water and sediment, in many cases enough to start stream channel and bank erosion. Several instances were observed where deterioration of the streambank and channel started at the point where road drainages entered the stream. This deterioration grew progressively worse downstream. *The contribution of water and sediment from the road drainage served as a trigger which started extensive down-stream damage.*

Another unsatisfactory condition was observed at several culvert installations on permanent roads. Channel and streambanks above the culverts were in good condition, although showing signs of having handled very large volumes of water. The culverts were well designed to handle even larger volumes of water than those passing through during the storm period. There was no culvert failure but the channel and streambanks below the culvert outlet were badly damaged and in an unstable

condition. Apparently the increased velocity and depth developed in passing the water through the constricted culvert created enough head to start erosion in the outflow area. The deterioration started there continued on downstream. It is apparent that further consideration should be given to providing a stable outflow area below permanent culvert installations in order to prevent them from becoming a trigger which sets off downstream channel and bank deterioration.

It was noted on several occasions that streams draining almost completely forested areas were in terrible shape and showed signs of having carried much more water and sediment than others. Further investigation disclosed that one or more of the recreational dams in the headwaters of these streams had washed out. *The surge effect resulting from the breaching of the structure was primarily responsible for much of the damage to the channel and streambank.* The debris and sediment dislodged and moved by the excessive volumes of water, resulting from these structural failures, created numerous temporary dams at downstream bridges and other channel constrictions and measurably increased flood damages from the storm.

One such structure on the Upper Brodhead impounded about 1,000-acre feet of water in a lake used primarily for fishing. Under normal conditions there was about a six-foot free board above spillway level. Storm Connie left the lake well above normal with a strong flow over the emergency spillway. Storm Diane completely filled the lake to the top of the dam before the emergency spillway failed. It is estimated that approximately 2,000-acre feet of water were released into the Brodhead within a very short time when this happened. This volume of water, together with the debris and sediment it picked up, contributed heavily to downstream damage.

Bushkill Creek, adjacent to Brodhead Creek, although smaller in area and with less rugged topography, had quite similar land-use characteristics. It also contained numerous dams creating recreational lakes. Only a few of these dams breached, however, and although Bushkill of these dams broached, however, and although Bushkill Creek had a high flood peak, damages were not as severe. It could be inferred from a comparison of these two streams that the failure of the impounding structures with their concurrent surge effect was primarily responsible for the heavy damage in Brodhead.

Dilldown-Pocono Region. Field examinations in this area were generally limited to the Pocono and Dilldown Experimental Forests. Runoff was very heavy on all forms of land use and visual observations made during the worst of Diane's precipitation indicated that type of land use had little effect on volume of runoff. There was no way of determining the effect of land use on the timing of flood peaks. Storm Connie, supplemented by

Figure 2. Debris washed down with a surge of water from a breached dam plugged this three-span stone bridge until sufficient head was developed to wash out a span and a portion of the approach fill. The trees in the center and right foreground (apparently standing) were a part of the debris.

contributions from several storms occurring between it and Diane, filled most of the available soil moisture storage space. Records of soil-water content collected in the upper 27 inches of forest soil at three stations on the Dilldown watershed indicate, in part at least, why forest land produced a great amount of runoff during periods of intense precipitation.

Average Soil-Water Content—Dilldown Forest Soils
(Before, during, and after storm period)

Date	Water stored in top 27 inches of soil	Period
August 10	4.79 inches	before Connie
August 15	7.48 inches	after Connie
August 16	7.27 inches	after Connie
August 17	7.08 inches	after Connie
August 19	7.76 inches	during Diane
August 22	6.90 inches	after Diane

Field capacity of the soils studied was computed to be 7.26 inches and total saturation capacity to be 8.81 inches. Therefore, there was very little storage capacity, probably less than two inches, available in the Dilldown soils when Diane arrived. Similar conditions with respect to the ratio of total storage capacity to available storage capacity in the soil profile probably existed over all of the high runoff areas. It should be noted that forest soils in other areas may have a greater storage capacity between field capacity and saturation than Dilldown soils, since the A and B horizons in the Dilldown profile are generally quite thin.

Figure 3. Lack of cross-drainage on this long grade on a secondary road resulted in ditch erosion and deposition of erosive material in the stream channel at the bottom of the grade.

New England Region. A very extensive examination of conditions in northwestern Connecticut and southwestern Massachusetts indicated that roads were the primary sources of erosion and sediment from forested areas. Steep, improperly drained roads gullied and washed, dumping tons of earth and rock on highways and in streams. Poorly located roads, close to stream channels, approaching stream crossings at an angle, or built in draws, served as wet weather channels during the storm and were entirely washed out, contributing large quantities of sediment and debris to floodflows. Culverts and bridges, located too far apart or with limited capacities, plugged and washed out. Earth slides were frequent along both streams and roads on very steep slopes even though some of these slopes were well forested.

Streambank cutting and scoring were common, especially where previous logging operations had disturbed cover and created unstable conditions. *Good location and adequate drainage paid off on the few good woods roads observed. Well vegetated old roadbeds eroded very little under heavy surface runoff except when they were hit by a head of water.* There were few evidences of excessive overland surface flow in forested areas of New England. In this examination these were found only on slopes above 65 per cent. On those steep grades even good forest cover failed to prevent overland flow entirely.

Forest Hydrologic Condition

Forest hydrologic condition is closely related to litter and humus depths since these factors have a pronounced effect on the infiltration and percolation rates of forest soils as well as on the ability of the soil profile to store water. Studies have indicated that, for the northeast, stand-size classes are a good and readily available indicator of humus type and depth and, therefore, of forest hydrologic condition in the area. In general, good forest hydrologic conditions are developed and maintained by good sawtimber stands and grow gradually poorer as stand-size class declines progressively from sawtimber to pole, to seedling and sapling, to reproducing stands. Other factors, such as fire, grazing, and past cutting practices will reduce the hydrologic efficiency of a given stand-size class. This is especially true in the small pole, seedling and sapling, and reproducing stands. Information collected during the field examination provided a basis for determining the general effect of these factors on hydrologic condition and, when interpreted with forest survey data for the storm area, permitted development of the following hydrologic condition class table:

Forest condition class	Per cent of total forest area	Per cent in hydrologic condition class		
		Good	Fair	Poor
Sawtimber area	18			
Over 5000 bd. ft. per acre		14.0		
Less than 5000 bd. ft. per acre			61.0	25.0
Poletimber area	49			
Over 600 cu. ft. per acre		4.0	45.5	5.5
Less than 600 cu. ft. per acre			16.0	29.0
Seedling and sampling area	29			100.0
Reproducing area	4			100.0
Total and summary forest hydrologic condition classes	100	5.0	41	54

Summary

A survey of several badly flooded watersheds in the northeast indicates that forest land, even in its present relatively poor hydrologic condition, was more effective than other forms of land use in retarding the movement of runoff to stream channels. A forest cover intercepts precipitation, provides a litter cover on the surface, and develops a humus layer which improves infiltration conditions and permits more water to enter the soil profile. (Water in the soil profile moves towards stream channels as subsurface runoff at a much slower rate than surface runoff and contributes less volume to flood peaks.)

Transportation systems through forest land, those in current use as well as the abandoned ones, are principal sources of runoff and sediment in forested areas. These facilities, unless properly located, adequately drained, and stabilized after abandonment, contribute large amounts of water to flood peaks. They are also the major source of erosive sediment which causes stream channel and bank deterioration and increases downstream damage.

A great deal of the extraordinarily high damages on some Pennsylvania streams resulted from failure of structural developments.

More than half of the forest land in the storm area was in poor hydrologic condition because of past management practices. Consequently, the forest lands as a whole did not function as efficiently as they should have in reducing flood peaks.

Field examinations indicated that while forest lands contributed a lot of sediment and debris to stream channels, they did not make these contributions unless there had been uncommon disturbances of forest conditions such as those caused by roads, skid trails, repeated forest fires, and heavy livestock grazing.

Because of the extraordinary climatic conditions, it is probable that forest lands would have made substantial contributions of water to peak flows even if forest hydrologic conditions had been ideal. The reservoir contained in the forest soil was practically full when the most intense rainfall occurred. Under such circumstances the land could not provide much additional storage space and its major flood reduction benefit was that of delaying water movement to stream channels by passing it through subsurface channels or surface vegetation. *Improvement in the forest transportation system, particularly in providing adequate drainage facilities on the currently used roads and in stabilizing the abandoned roads, would have substantially decreased the surface runoff by dispersing rather than channelizing it and would have reduced sediment contributions.*

1955 Flood Damages to Land in the Northeast

The floods of August 1955 were an unprecedented disaster in a large area in the northeastern United States. They rank among the most destructive in the country's history. Augmented by the antecedent hurricane storm of August 11-15, the rainfall of August 17-20 accompanying hurricane "Diane" reached maximum values of 17 to 19 inches in south central Massachusetts. Record breaking floods resulted.

Damage To Agricultural Land In Connecticut Was Severe

By N. Paul Tedrow

AUGUST IS normally a low rainfall month in Connecticut. The first ten days of August 1955 were hot and dry. Many farmers were using supplemental irrigation. Pastures were turning brown and crops in general were suffering from lack of moisture.

Then the rains came! From the 10th to the 16th up to five inches of rain fell throughout the state. It was a slow, easy rain that rapidly saturated the soil and filled ponds and reservoirs. Pastures and hayfields again turned green and irrigation equipment ceased to operate. Hurricane Diane was now reported moving up the east coast. Local residents were keeping a close watch on its progress. Although the winds lost their hurricane force as they passed over eastern Virginia, the accompanying rains

Figure 1. *Left:* Streambank erosion along a corn field in the West Granby area, Connecticut. *Right:* A tobacco field destroyed by flood waters.

proceeded northward through eastern Pennsylvania, New York and Connecticut.

Heavy rain began to fall in western Connecticut on the 18th. During the night the rainfall was intensified. Warnings were issued of the immediate danger in several communities. However, many people had retired for the night and did not hear the warnings. In a matter of hours the rising waters isolated busy industrial centers such as Winsted, Torrington, Waterbury and Putnam. Smaller communities such as Unionville, Collinsville, New Hartford and Seymour were equally hard hit as tiny streams swelled into raging torrents. Roads and bridges were washed out. Whole business blocks and factories were destroyed within a few hours. The list of people dead or missing neared the hundred mark.

When the rain was over, ten to nineteen inches were recorded in western and northern Connecticut over the two-day period. Damage to farmland was not as dramatic. However, the flood has left a permanent scar on the Connecticut landscape. The loss of crops, farm buildings, livestock, machinery and seedings amounted to $2,545,362 according to a survey completed by the various agricultural agencies.

It is very difficult to put a dollar value on the land that was damaged or destroyed by the flood. Detailed surveys were made on the flooded area of three typical streams to get an estimate of the total damage in the state. The area surveyed included the Blackberry River in Litchfield County, Salmon Brook in Hartford County, and the Scantic River in Tolland County. Projecting these surveys to cover the area of the state damaged by the flood, it is estimated that approximately 13,000,000 cubic yards of debris was deposited on 12,664 acres of the flood plains of small tributaries to major streams. Where the deposit is silt or sand less than six inches deep, the land can be reclaimed by disking or deep plowing. Where the deposit is primarily sand and gravel, it will be necessary to remove the material mechanically if the land is to be used for agriculture. An examination of some areas revealed that most of the soil to plow depth was removed before other material was deposited.

Many people were content to believe that a similar flood would not occur in the next hundred years. However, before temporary repairs were completed on the bridges and highways, a second flood occurred.

On October 16 and 17 up to twelve inches of rain fell in western Connecticut. Again damage to roads and bridges ran into millions of dollars. Much of the temporary work recently completed was again destroyed. The loss of life was not as great, probably because the worst flooding occurred during daylight hours, and people had received warnings of immediate danger.

Many local communities now realize the necessity for an adequate watershed protection program. Much of the damage that occurred was on the small streams and tributaries of the larger streams.

N. Paul Tedrow, a member of the SCSA, is state conservationist, Soil Conservation Service, with headquarters in Storrs, Connecticut.

Massachusetts Farms Suffer Two Million Dollar Loss

By Arthur B. Beaumont

"The rains descended and floods came" in southern New England, August 17-19, 1955. Yes, they really did, just as it says they did in the Biblical parable. Nothing like it was remembered by the oldest inhabitant. All records were broken. "The worst flood since Noah's," some said. At Holyoke, Massachusetts, 15 inches of rain were recorded in 25 hours. Unofficial measurements for the same storms were as high as 20 inches. Damage to farm land, highways, homes, and factories was terrific. The way the problem of repair and restoration has been tackled is a tribute to the courage, optimism, and ingenuity of the affected farmers.

Water, like fire, is "a good servant but a poor master." The truth of this adage was emphasized by recent events. Water, under control, can turn the wheels of industry, irrigate crops, provide a medium for recreation and supply a thousand needs, but uncontrolled water on rampage can be most devastating. Many people for the first time had

Figure 1. This shows the new channel of Little River near Westfield, Massachusetts. It was cut through pasture land and is more than 2000 feet long and 100 feet wide.

Figure 2. *Left:* This gully in a pasture field averages 30 feet wide and 10 feet deep. The soil material settled on a flat area at the lower end of the field. *Right:* Once a highly productive potato field. The damage here was caused by flood waters of the Little River in Massachusetts.

this fact indelibly impressed on their minds. The tremendous erosive action and carrying capacity of swiftly moving water was most impressive.

The most severe damage to agricultural land occurred where water was concentrated in and around stream channels, and in natural depressions where water flowed from mountainsides. Excellent alluvial soil was in places scoured out and gravel and sand deposited in place of the soil. In other places deposits of boulders, gravel and sand of various depths were laid on top of good soil. In a few places deep and wide gullies were cut in good land, and some streams jumped entirely out of their old channels and cut new ones through cropland.

Both the erosive or cutting power and the carrying capacity of running water increase at a much greater rate than the velocity increases. For example, hydraulic engineers have found that doubling the velocity of running water will enable it to roll along on stream bottoms stones weighing approximately 64 times as much as those it would move at the lower velocity. These facts account for some of the amazing results seen in new stream channels, gullies, and boulder displacements. In and near streams which debouched from mountainsides in southern Berkshire County boulders weighing 500 pounds to a ton were common. There were many moved that weighed three to four tons, and one that weighed approximately eight and one-half tons was observed. In Hampden County it was noted that a boulder weighing nearly a ton was transported or rolled a half-mile on a pasture.

Scouring and deposition, alone or in combination, were a cause of much damage to farm land. Often land damaged in these ways was the most productive and valuable. There was an outstanding example of this kind of damage in Hampden County. Little River cut a new channel through a tobacco farm, causing land damages which were estimated to cost $40,000 to repair and restore the stream to the old channel. In the town of Sheffield, Berkshire County, rampaging waters cut a new gully of tremendous size through a mowing and deposited rock debris on lower crop land.

In Spencer, Worcester County, 30 acres of good cropland on one farm were covered by two feet of coarse sand, and five acres by silt two to three feet deep.

In addition to land damage, many acres of standing crops, valued at several hundred thousand dollars, were destroyed. In Middlesex County damage was limited mostly to crop losses. Total crop losses for the state due to the August rains and floods have been estimated to be $949,000 by the Massachusetts Extension Service. Land damage was estimated at $580,000 making a total of $1,529,300. This amount doesn't include land and crop damage caused by the October 14-17 rains, which was considerable in Franklin County, nor the damage to farm buildings, fences and stock. Altogether damages to farms by the two floods approximate $2,000,000. In addition, there was tremendous damage to highways, bridges, industries, and urban residences, which is not considered in this appraisal, but runs into millions of dollars.

Much of the damage in narrow valleys was caused by the breaking of old, poorly constructed dams. Seven dams broke in the Cady Brook watershed in Southern Worcester County, thus releasing millions of gallons of water which contributed to the large amount of damage suffered by Southbridge and the big optical works located there.

Damage to upland farm land and crops was relatively minor. Newly seeded fields of grass suffered most. Farms protected by established soil conservation practices suffered little or no damage. No dams constructed with technical assistance received through soil conservation districts failed.

Arthur B. Beaumont, a member of the SCSA, is state conservationist, Soil Conservation Service. Mr. Beaumont's headquarters are in Amherst, Massachusetts.

THE NORTH AMERICAN MIDWEST—*A Regional Geography, Edited by* JOHN H. GARLAND, *John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, New York. 252 pages. 1955. $8.00.*

This "only geography of the Midwest United States" is ably edited by John H. Garland, Department of Geography, University of Illinois. He points out that "the Midwest is not only unique as all regions are unique earth areas, it is exceptional in that as a total region this extensive interior land, far distant from both mountain and sea, is a gigantic center of agriculture, manufacturing, and transportation unexcelled or perhaps unequaled anywhere. As such it exerts a dominating influence on the affairs of the nation and indirectly on the world. It is, perhaps, the most important single region in North America and one of great significance in the future of the western world."

While the book is a joint project, written by fifteen contributors, each of whom prepared a topic of his specialty on a midwestern region of which he had an intimate knowledge, the material has been blended into a well-coordinated whole.

Dr. Garland's analytical and keenly appreciative appraisal of the "geographic phenomenon," as he terms the Midwest, may seem overenthusiastic to some. It typifies, deepens, and vivifies the pride of prairie-born midwestern agriculturalists for whom this book will be interesting reading, thought-provoking, and worthy of discussion and reference.

Part I, *A Point of View,* relates the Midwest to the North American geographic structure. The editor states that this book is concerned with the internal geographic structure of the Midwest, and that emphasis is placed upon the dominant qualities of the various human, cultural, and natural environmental associations. In view of this, it is unfortunate that the pioneer work of Howard W. Odum and Harry E. Moore in *American Regionalism,* 1938 (representing as it does some of the first efforts at empirically delineating and describing regions in the United States), is not mentioned in the bibliography of this book. Odum and his associates used over 700 indices in developing six major regions in the United States, including the "Middle States" region.

Part 2, *Midwestern Elements,* contains five chapters covering the subjects "Weather and Climate," "Settlement Forms and Patterns," "Significance of Agriculture," "Structure of Industry," and "Trade and Transportation." Each topic is treated in a systematic fashion that gives the reader an excellent picture of how they apply to the Midwest and its relation to the surrounding area. The chapter on settlement forms and patterns depicts the present rural and urban growth pattern.

In reviewing the chapter on significance of agriculture, one questions the disregard of F. F. Elliott's work on types of farming in the Midwest. Elliott pioneered in delineating farming type areas and through the United States Department of Agriculture, published "Types of Farming in United States," 1933.

Part 3, *The Inner Midwest,* covers four chapters—(1) The West-Central Lowland, (2) The East-Central Lowland, (3) Eastern Lower Great Lakes, (4) The Upper Mississippi Valley. The authors state that the West-Central Lowland has contributed the most of all of the regions to the significance of the Midwest—its importance rests upon its outstanding agricultural characteristics—it includes southwestern Minnesota, most of Iowa and northern Missouri, central Illinois and northwestern Indiana.

The author does not indicate data and source of some of the agricultural statistics which is disturbing to this agriculturally trained reviewer.

The author concludes that corn, oats, soybeans, hay and livestock are the commodities that give the West-Central Lowland its name and fortune.

"Corn belt and general farming, diversified manufacturing in small cities, strip and shaft coal mining—these are the characteristics of the East-Central Lowland."

Thomas F. Barton, author of Chapter 8, "The East-Central Lowland," is to be commended except for his description of agriculture. In describing present methods of corn picking, he says "he (the farmer) need not do chores before daylight unless he chooses, since he must wait until the sun takes the frost and dampness from the stalks before he starts" (page 120). This is true of soybean combining, but the best corn picking time is early in the morning when the frost and dampness are still on the stalks and husks.

Part 4, *The Midwest Periphery,* covers "The Upper Great Lakes" ("an overpopulated region dependent upon an extractive economy"), "The Upper Ohio Valley," "The Lower Ohio Valley" ("an area of physical and cultural complexity"), "The Ozark Upland," "The Lower Missouri Valley," and "The Upper Missouri Valley."

Despite some points of issue, this reviewer feels that it is an excellent book, worthy of a wider reader interest than its title and subtitle might attract.

—E. L. SAUER, *Champaign, Illinois*

CATTLE AND MEN. By Charles Wayland Towne and Edward Norris Wentworth. *University of Oklahoma Press, Norman. 384 pp., illus. 1956. $4.00.*

This book completes a trilogy in the popular vein by this team of writers on the species of meat animals—cattle, hogs, and sheep. Colonel Wentworth has had to his credit for two decades authoritative how-to-do-it books on raising the three kinds of livestock and on marketing them, subjects for which his work with Armour's Livestock Bureau qualified him. He also has given us a definitive history of sheep in America, in *American Sheep Trails* (1948).

By comparison with these more serious works, this book suffers somewhat from its effort to capture the reader's interest with the odd fact and the cute phrase. It ranges through a myriad of unfamiliar items turned up in searching the history of the association of man and his principal beast of burden and food from prehistoric times to the present. Some of the familiar but central themes of this history are but lightly touched.

The conservationist will find little in this book to add to his insight of grazing land problems, as he might have expected from the subject. The viewpoint is strictly that of the livestock man interested primarily in his livestock, not in the land.

—Ben Osborn, *Washington, D. C.*

Sense of Using Dollars

(Continued from page 131)

and operator.

Investment in conservation paid dividends on most of the farms studied. On some it changed the business from a losing to a paying proposition. Production and incomes were relatively better on the case farms after adoption of a conservation plan suited to the capabilities of the land and the abilities of the owner and operator.

By improving both present and future productivity, a conservation program usually increases net income in one to four years after it is started. The returns provide a safe basis for establishing credit to put the conservation program into effect.

Influence of Deep Tillage on Intake and Storage of Water

By R. J. Hanks and F. C. Thorp

Due to a clerical error in the original manuscript, a section was omitted from this article which appeared on page 81 of the March 1956 issue of the Journal of Soil and Water Conservation. *To avoid any misconceptions about deep tillage, which currently has widespread interest among our readers, the complete article is being reproduced in its entirety.*—Editor

GREAT PLAINS FARMERS have long been interested in deep tillage to conserve moisture, by increasing water intake into the soil. They have had little factual data to support their interest but have tilled considerable acreage with a wide variety of chisels and sub-surface sweeps. Experiments were set up at several locations in Kansas beginning in 1952 to determine the influence of deep tillage on intake and storage of water. So far, the results have been negative.

In July of 1952 a test was initiated in Finney County on a fine sandy loam with a distinct plow pan. Soil moisture measurements made since then have showed no increase in moisture storage due to deep tillage. Tests made using an infiltrometer in 1954 and 1955 have shown no increase in the infiltration rate of water. Wheat yields in 1955 were 11.3 bushels per acre on the check plot, and 10.5 bushels per acre on the chiseled plot. The tillage marks, however, can still be found easily with a probe.

Tests were initiated at Hays, Kansas, in June of 1953 on a silty clay loam with a tight subsoil. Deep tillage consisted of chiseling to 24 inches and using subsurface sweeps at 18 inches. Measurements of soil moisture have indicated no increase in moisture storage due to either method of deep tillage. Infiltration tests made in 1954 and 1955 indicate no increase in infiltration rate. It has been almost impossible, since 1954, to find the tillage marks. Wheat yields in 1955 were 39.1 bushels per acre on the check plot, 39.4 bushels per acre on the chisel plot, and 39.5 bushels per acre on the sub-surface sweep plot.

Similar experiments were set up in 1954 in Geary County on a silty clay loam with a tight subsoil, in Clay County on a clay loam, and on a Keith silt loam in Thomas County. In 1955 an experiment was set up in Pratt County on a very fine sandy loam with a clay pan. The results of infiltration measurements made in 1954 and 1955 indicated no difference in infiltration rate due to deep tillage. Infiltration measurements were made on the Pratt, Geary, and Clay County plots within a month from the date of tillage. The yield of wheat on the Geary County plots in 1955 was 30.4 bushels per acre on the check plot and 32.7 bushels per acre on the chiseled plot.

Measurements of soil moisture storage and infiltration of water have indicated no difference in moisture intake or storage due to deep tillage. Likewise there has been no increase in wheat yields due to deep tillage.

R. J. Hanks and F. C. Thorp are agents (Soil Scientists), Western Soil and Water Management Section, Soil and Water Conservation Research Branch, ARS, USDA, Manhattan, Kansas, and Kansas Agricultural Experiment Station, Cooperating.

Field Notes

Edward A. Colman Memorial Fund Established for Watershed Research

The ideals and accomplishments of the late Edward A. Colman will be commemorated through a memorial fund recently established by his family and friends to aid in training young men for graduate research in watershed management. Clark H. Gleason of Oakland, California, a member of the SCSA, is chairman of the fund.

"Ted" Colman

Mr. Colman, chief of Watershed Management Research for the United States Forest Service in California since 1949, died in Berkeley last March 20. He was 45 years old and had been ill a short time. Mr. Colman was also chairman of the San Francisco Bay Chapter of the Soil Conservation Society of America.

"Ted" Colman was recognized as an authority on forest and watershed problems. He began his work in Minnesota and Idaho 25 years ago and had been with the California Forest and Range Experiment Station since 1932. Mr. Colman specialized in soil physics and forest hydrology.

Among his recognized accomplishments was an improved method of extracting moisture from soil samples. He later patented an electrical soil-moisture meter now being used throughout the world. In 1951 he did a special water yield improvement study and had his findings published in *Vegetation and Watershed Management*. He later laid the groundwork for a comprehensive snow study to improve water yields in the Sierra Nevadas and his faith in basic research also carried into other fields.

New York Conservation Forum Schedules Caravan for Late Summer

The Conservation Forum of New York State, a leading citizen organization, and the Buffalo Museum of Science, which is known nationally and internationally for its leadership in education, are offering for the eighth season their unique adventure on wheels, *the Conservation Caravan*. From August 25 to September 1 the Caravan will be on the road, touring parts of western New York and Pennsylvania and eastern Ohio to study soil, water, forests and wildlife with the aid of many specialists.

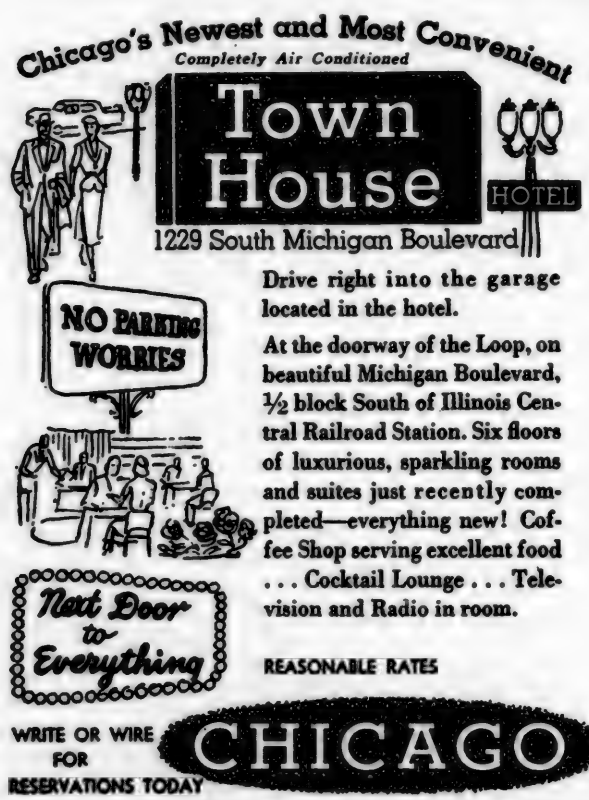
Educators, scientists, farmers and officials of government bureaus will be instructors as the group visits wildlife refuges, parks, farms, scenic areas, an agricultural experiment station, a college camp where students and teachers together practice conservation, a primeval area in the Allegheny National Forest, the Muskingum Watershed Conservancy District in Ohio and the late Louis Bromfield's famed Malabar Farm.

Further information may be had from the director of the Caravan, Miss Mabel H. James, Buffalo Museum of Science, Buffalo 11, New York.

Conservation Awards Program Announced By Nash Motors

Continuation of Nash Motor's Conservation Awards Program was recently announced by George Romney, president of American Motors Corporation.

The program, instituted in 1953, annually singles out 20 conservationists for their outstanding efforts. Ten awards, each consisting of $500 and a bronze plaque, go to professional conservationists, and ten awards of bronze plaques go to non-professionals.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Next Door to Everything
REASONABLE RATES
WRITE OR WIRE FOR RESERVATIONS TODAY
CHICAGO

Nominations for the awards can be made by letter. Supporting documentary evidence should be included. Nominations should be sent to Nash Conservation Awards Program, Room 1700, 745 Fifth Ave., New York City, N. Y. Entries will close August 15 and award winners will be announced about November 1.

Society Should Be Concerned About Man as Well as Resources

Dear Mr. Pritchard:

Your article in the last issue of our JOURNAL was well done. I read it with interest and profit. It was challenging, as you intended.

It is personally gratifying to be a member of an organization that has accomplished so much in such a short time. We all share this feeling of satisfaction. Inherent in such recognition is the possibility of members becoming complacent. With this you are concerned and correctly so. The potentials and need for a Society such as ours has now been established. We must retain our "hybrid vigor." Some of the essentials for doing so are the continuance of our conceiving *needs* and providing a forum for their review. *What does it take to get the job done?*

Both Russell Hill and Dr. Firman Bear made thoughtful, objective comments. I can go along with Mr. Hill on changing the name of our Society. I like his proposals. Land is much more descriptive than soil. I like the idea of the Society sponsoring *"Symposia on resource use."*

Dr. Bear was thinking in like vein when he wrote ". . . It is designed to be of service to all people of this Nation, . . . He also mentions ". . . Evangelism of a high order." Within the meaning of this word is to be found the potent catalyst that moved men to determined action. We must retain this motivating force.

Evangelism is of and for man. The end products of our Society's interests and objectives are the application and retention of effective land and water conservation measures. Accomplishment depends entirely upon man's acceptance of needs and methods. This fact is accepted but I wonder how many Society members accept the fact that the limitations of their own professional endeavors are circumscribed by landowner ignorance, indifference, and failure to accept social responsibilities that are ethically his.

Some leaders are recognizing that there are personal and economic limits to which landowners will or can go in applying and maintaining soil, water, and plant resource conservation measures. *Of what concern is this facet of land and water conservation to our Society? I think we should be concerned about man as well as about land, soil and water.*

—A. C. MCINTYRE, *Upper Darby, Penna.*

USDA to Launch Soil and Water Conservation Needs Inventory

Secretary Ezra T. Benson has announced that the Department of Agriculture is making a national inventory of soil and water conservation needs.

The inventory is intended to equip the Department to more effectively plan and carry out its soil and water work. Plans call for completing the initial inventory in three years, with periodic revisions thereafter to keep the figures up to date.

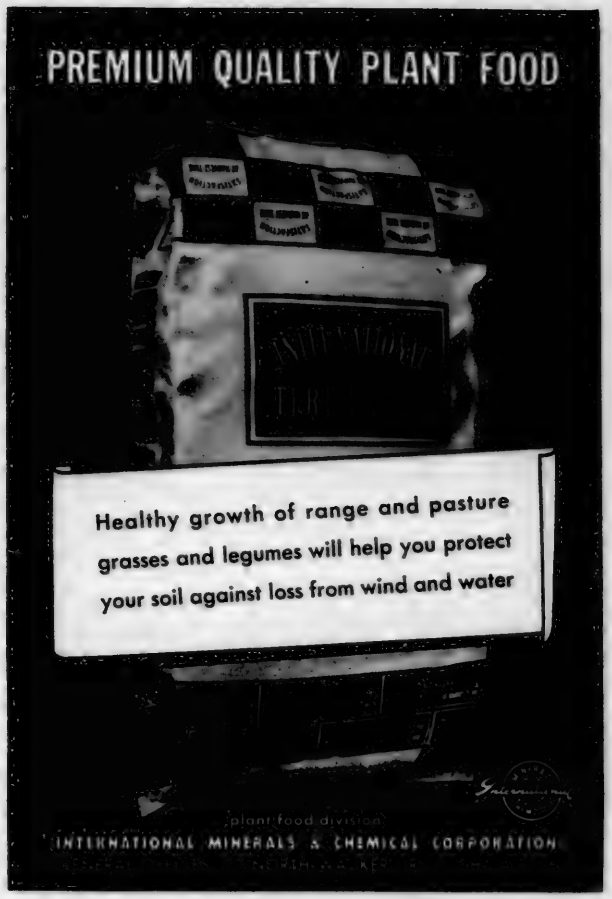
"With the inventory, we can make reasonable estimates of the magnitude and urgency of the various conservation measures needed to maintain and improve the country's productive capacity for all the people," Secretary Benson said.

The inventory will be made for each county in the United States. It will provide basic facts about the amount and kind of soil, water, and plant resources as well as a realistic estimate of treatments needed to best protect and improve those resources.

The Secretary's memorandum setting up the inventory program directs the Soil Conservation Service to carry out the study with the help of the Agricultural Conservation Program Service, Agricultural Research Service, Commodity Stabilization Service, Federal Extension Service, Farmers Home Administration and Forest Service.

Representatives of those agencies will make up a national Soil and Water Conservation Needs Committee which will develop procedures and guide the program. Comparable committees in the States and Territories will be named to carry out the work at that level.

In addition, the Secretary said, cooperation of state and local agencies, organizations, and groups concerned with soil, water, forest, range and wildlife conservation will be actively solicited. These include the land-grant colleges, soil conservation districts, state forestry and conservation departments, water agencies, and similar groups. Federal agencies responsible for land management in other Departments will be asked to help obtain data which can be used in the inventory.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In The News

George Johnson, chairman, Iowa Chapter of the SCSA and associate editor of SUCCESSFUL FARMING, recently joined the Agricultural Department of the E. H. Brown Advertising Agency of Chicago.

Mr. Johnson joined Successful Farming in 1950 as soils, crops, and agricultural chemicals editor. In 1955, he received the *Soil Builders Award* of the American Plant Food Institute for having produced the nation's outstanding soils editorial program in a farm magazine.

Kenneth B. Pomeroy, one of the top forest management research specialists in the United States Forest Service, has been appointed chief forester of The American Forestry Association effective July 1. He succeeds Lowell Besley who has accepted a position with the Pulp and Paper Research Institute in Canada. Pomeroy will be part of a two-man team at AFA: Fred Hornaday, now AFA secretary, will assume control of administrative duties, while Pomeroy handles AFA policy and forestry program.

James K. Vessey was recently named assistant regional forester for the Forest Service, North Central Region, headquartered at Milwaukee, Wisconsin. He will be in charge of Forest Service participation in cooperative fire, tree planting, and on-the-ground technical assistance programs with state agencies and private timberland owners in North Dakota, Wisconsin, Minnesota, Missouri, Iowa, Illinois, Indiana, Ohio, and Michigan. Prior to this assignment Mr. Vessey was assistant regional forester in charge of information and education for the Northern Region at Missoula, Montana.

News Notes

PRESIDENT'S COLUMN

The relationship of the world's human population to its natural resources has been treated so variously and so profusely that we tend to become insensitive to it. It is therefore of interest that some of the great minds of the world have recently emphasized the relationship. Dr. Vannevar Bush, in his 1955 report as retiring President of the Carnegie Institution of Washington, writes that ". . . wars aside, man is still headed for trouble. The world's population is increasing at a rate which renders distress, famine, and disintegration inevitable unless we learn to hold our numbers within reason. New methods of extending the food supply, powerful though they may be, can only postpone the crisis, and perhaps allow time for communication and education to produce the general understanding that is essential to a sound solution of the underlying problem."

E. H. Graham

Bertrand Russell has pointed to three major sets of relationships in man's existence: man to himself, man to man, and man to environment. Russell has written, in his book, "New Hopes for a Changing World," published by Simon and Schuster in 1951, that he believes one of the critically serious problems of the modern world is the balancing of world population with the resources the earth's environment provides.

In 1954 the Viking Press published a book by Harrison Brown, of the California Institute of Technology. The book was entitled "The Challenge of Man's Future," and it dealt in masterful and comprehensive fashion with the whole complicated business of machine living, food and energy, and human numbers on a world scale. Commenting on the book, Albert Einstein wrote: "We may well be grateful to Harrison Brown for this book on the condition

(Continued on page 145)

South Carolina Schools Use "The Story of the Land"

Left Photo: Shown above is Earl Glasscock, supervisor of Catawba Soil Conservation District presenting the booklet "The Story of the Land" to Fifth Grade teachers at Northside School in Rock Hill, South Carolina. The booklet was provided for each child in the Fifth grade of York County by the Rock Hill National Bank. Left to right: Miss Callie Thomas, teacher; Miss Lucille Allen, teacher; Mrs. Clara Bell Snavely, secretary; Mrs. Betty Spencer, teacher, and Earl Glasscock. Right Photo: Mrs. Betty Spencer, fifth grade teacher, and two of her students, Marshall Brooks and Phyllis McAbee, discuss "The Story of the Land."

The 9,675 Fifth Grade pupils in the eight soil conservation districts served by SCS Area II in South Carolina received a conservation treat during the 1955-56 school year. Each of these children received a very interesting and attractive illustrated booklet with appeal for young and old. The title of the booklet, as an SCSA member would probably have guessed, is "Through the Centuries! The Story of the LAND—Its Use and Misuse."

The booklet was developed by a committee of the Soil Conservation Society of America. It is designed to tell the story of soil and water conservation to children and their parents. It is pointed out in the publication that we not only must cease to exhaust our soil, water, farms, forests and wildlife—we also must replenish and improve these assets to keep pace with the growth of our nation, whose future population will demand more production from the nation's land.

In some districts the booklet was distributed by inviting the Fifth Grade teachers to meet with the Board of Soil Conservation District Supervisors. The Supervisors of the Catawba Soil Conservation District, however, decided to go even beyond that. They divided a list of all the Fifth Grade teachers among the five supervisors, who in turn visited each Fifth Grade teacher, discussed the teaching of conservation in the school and left the necessary number of copies of the booklet.

Sponsors who made this possible are:

Sponsor	Address
Merchants and Planters Bank	Gaffney
Commercial National Bank	Union
The S. C. National Bank	Newberry
Merchants and Planters Bank	Winnsboro
Dixon Tire Service	Lancaster
Victor Fertilizer Company	Chester
John A. Black, Rock Hill Nat'l. Bank	Rock Hill
Spartanburg SCD	

—J. B. Earle, *Chairman*
South Carolina Chapter

Sale of "The Story of Land" Tops Half-Million Mark

Soil Conservation Districts, farm equipment dealers, banks, and other friends of the Soil Conservation Society of America have continued to distribute copies of the booklet "The Story of Land" at a fast pace. It is anticipated that many booklets will be used at county fairs during the summer months and that any other localities will make arrangements to distribute copies with the opening of school next fall.

Orders for the booklets with back page imprinting should be placed well in advance of the time the booklets are desired as there has been some delay in delivery on occasion. Booklets without back page imprinting are shipped without delay.

The following orders for 1,000 or more copies of the booklet have been received since the list was published in January. (Many orders have been received for lesser quantities):

Canadian-Walnut SCD, Purcell, Okla.	1,000
D. N. Grimwood, Paris, Ky.	1,000
J. H. Campbell, Statesville, N. C.	1,400
St. Francis Co. SCD, Forrest City, Ark.	1,000
Winneshiek Co. SCD, Decorah, Iowa	3,000
Kent Co. Conservation League, Grand Rapids, Mich.	4,000
Big Thompson SCD, Loveland, Colo.	1,200
Burt SCD, Lyons, Nebr.	2,000
Soil Conservation Service, Mt. Vernon, Ohio	2,000
Saugeen Valley Conservation Authority, Walkerton, Ont.	2,000
Firman L. Carswell Mfg. Co., Kansas City, Kan.	1,500

(Continued on page 145)

MIX in '56

S·C·S·A ANNUAL MEETING
TULSA, OKLAHOMA – OCT. 15·16·17

Southern New England Chapter Holds "Winter" Meeting

A winter meeting on a "wintry day" was attended by 70 members and friends of Southern New England Chapter on February 2. Arranged by John McCuen as chairman of the Program Committee, the meeting was held at the Federal Land Bank, Springfield, Massachusetts and the bank provided a luncheon for all in attendance. The program was as follows:

"Wildlife in the Basic Land Program"—Philip Borske, Field Representative, Wildlife Management Institute.

"Go East, Young Farmer"—C. L. W. Swanson, Head, Dept. of Soils, Connecticut Agricultural Experiment Station.

"A New Method for Setting Slope Stakes"—William F. Warren, Soil Conservation Service, Springfield, Mass.

"Subsoiling and the U. S. Patent Office"—Ted W. Roberg, Bantam, Conn.

Address—Willis H. Hayes, Secretary, Federal Land Bank, Springfield, Mass.

"New Strains on Old Water Laws"—Clyde O. Fisher, Jr., Attorney, Springfield, Mass.

"Public Relations Problems in Watershed Work"—Dr. B. J. Isgur, Deputy State Conservationist, Soil Conservation Service, Mass.

East Texas Chapter

The executive comittee of the East Texas Chapter met early in the year to develop a program for 1956. The schedule of meetings and topics for discussion include:

February 17—Dinner meeting, Hotel Fredonia, Nacogdoches. "Costal Bermuda"—Floyd Sanders in charge.

April 7—Meet at 10:00 A.M., Science Building, S. F. A. Campus for forestry tour. U. S. Forest Service in charge.

(Continued from page 144)

Hubert B. Odor, Williamstown, Ky.	1,500
Ottawa Co. SCD, Miami, Okla.	2,000
Jefferson Co. SCD, Brookville, Pa.	1,000
Graves Co. SCD, Mayfield, Ky.	2,000
Trigg Co. SCD, Cadiz, Ky.	1,000
Stanton SCD, Stanton, Nebr.	1,000
Jasper Co. SCD, Bay Springs, Miss.	2,100
Bell Co. SCD, Pineville, Ky.	2,000
J. R. Adair, Lexington, N. C.	3,000
Crittenden Co. SCD, Marion, Ky.	1,000
Buckingham Farm Supply, Dillwyn, Va.	1,000
Christian Co. SCD, Hopkinsville, Ky.	2,000
Carl E. Haischer, St. Mary's, W. Va.	1,600
West Georgia SCD, Carrollton, Ga.	2,000
Gooding SCD, Gooding, Idaho	1,000
Cimarron Co. SCD, Boise City, Idaho	1,000
Assoc. of Ill. SCD, San Jose, Ill.	1,000
Midle Yadkin SCD, Mocksville, N. C.	1,000
Upper Sangamon Valley Conservation Service, Decatur, Ill.	1,000
J. O. Stickley & Son, Inc., Harrisonburg, Va.	1,000
Wetzel See Co., Harrisonburg, Va.	1,000
Central Chemical Corp., Harrisonburg, Va.	1,000
Caldwell Co. SCD, Princeton, Ky.	1,300
Hill Co. SCD, Havre, Mont.	1,300
Culpeper SCD, Culpeper, Va.	1,000
Union Co. SCD, Monroe, N. C.	1,500
Enloe Farm Tractor & Equip. Co., Franklin, N. C.	2,000
L. E. English, Franklin, N. C.	1,000
S. T. Adams, Bedford, Va.	2,000
Cabarrus Co. SCD, Concord, N. C.	1,500
Melvin Hamnes, Convick, Minn.	1,000
Frank Logan, Salinas, Calif. (Mission Soledad SCD)	1,000
Lyon C. SCD, Eddyville, Ky.	1,000
Campbell Co. SCD, Alexandria, Ky.	1,500
Division of Lands and Soil, Columbus 15, Ohio	1,000
Coosa River SCD, Anniston, Ala.	2,000

REMEMBER TO GET A NEW MEMBER

Society Membership Is Worldwide

A recent visitor to the national office was Sumith Abeywickrema of Morawaka, Ceylon. Mr. Abeywickrema and his family are tea planters. He is a leader of the Cooperative Youth Movement of Ceylon and is currently in the United States to attend a short course on soil conservation at Oregon State College. For many years his brother, K. P. Abeywickrema, Tea Research Advisory Officer of the Tea Research Institute of Ceylon at Maswela, has been a member of the Society.

The Society is proud of its membership in other countries. Following is a list of memberships in countries indicated—many of them are institutional or library memberships but many are also individuals:

Europe		Peru	6
Austria	1	Uruguay	3
Belgium	1	Venezuela	2
Cyprus	1	**Central America**	
Czechoslavokia	1	Costa Rica	1
England	4	El Salvador	2
France	4	Honduras	1
Germany	11	Mexico	7
Greece	4	Panama	1
Holland	25	**West Indies**	
Hungary	1	British West Indies	4
Italy	7	Virgin Islands	3
Netherlands	1	Haiti	2
Poland	1	**APO Addresses**	
Russia	11	New York	7
Scotland	1	San Francisco	4
Spain	3	**Canadian Provinces**	
Sweden	1	Alberta	5
Switzerland	1	British Colombia	4
Yugoslavia	4	Manitoba	8
Middle East		New Brunswick	1
Iran	1	Nova Scotia	3
Israel	15	Ontario	70
Kumwait	1	Quebec	2
Lebanon	1	Saskatchewan	7
Turkey	4	**Far East**	
Africa		Formosa	4
Algeria	1	Hong Kong	1
Egypt	1	Indonesia	1
French West Africa	1	Japan	4
Gold Coast	1	Malaya	1
Kenya	5	Philippines	8
Madagascar	3	**Asia**	
Nigeria	1	Afghanistan	1
Somaliland	1	Ceylon	5
South Africa	6	India	21
South Rhodesia	14	Pakistan	4
South America		Thailand	3
Argentina	2	**South Pacific**	
Brazil	12	Australia	14
British Guinea	1	Fiji Islands	1
Chile	7	New Zealnd	14
Colombia	5		
Ecuador	1		

Minnesota Chapter

The Leamington Hotel, Minneapolis, was the location of a meeting of the Minnesota Chapter on January 9, 1956. Program for the meeting was a discussion of the soil bank plan, which by coincidence was officially recommended to Congress on that day.

W. H. Kircher, Managing Editor, THE FARMER, St. Paul, served as moderator of a panel. Dr. O. B. Jesness, Economist, University of Minnesota, covered the subject—"Do Soil Plans Make Economic Sense?" while Dr W. P. Martin, Head, Dept. of Soils, University of Minnesota had the topic—"Do Soil Bank Plans Make Soil Sense?"

Elected chairman of the chapter was Alex S. Robertson, 1635 Niles Ave., St. Paul, Minn.

(Continued from page 144)

of mankind . . . The latest phase of technical-scientific progress, with its fantastic increase of population, has created a situation fraught with problems of hitherto unknown dimensions."

The men I have cited are not alarmists or prophets of doom. Bush and Einstein are physicists, Brown a geochemist, and Russell a mathematician. Working in the exact sciences, they are not given to reckless statements. Along with those in other fields of science, however, they recognize the population-resource problem for what it is, and they call for setting our sights beyond the day-by-day issues with which we are so often overwhelmed. Those in the physical, biological, and social sciences all have responsibility in evaluating this problem, stating the case, and suggesting solutions.

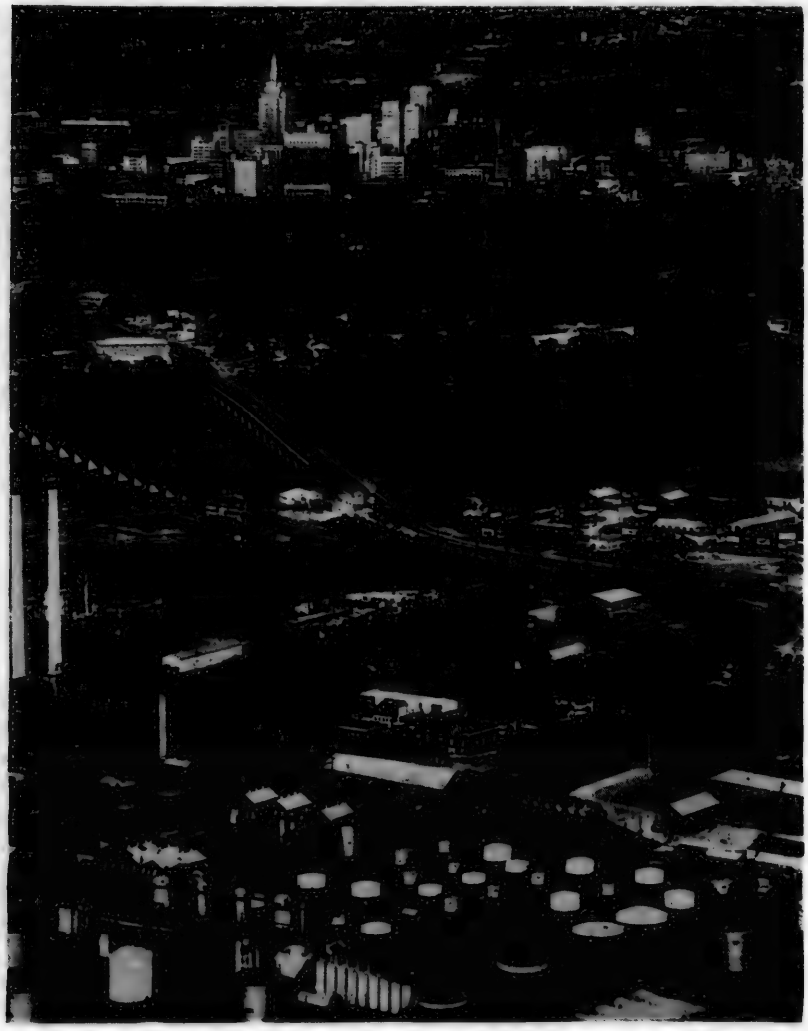
The Soil Conservation Society of America contributes to an understanding of this problem through its efforts to *advance the science and art of good land use.* Scientific knowledge of the land on the part of those who till it, graze livestock on it, or cut the timber it grows, is a fundamental step in better resource use. The Society provides a medium wherein professional personnel from many disciplines can think and work together, bringing their specialized knowledge to bear upon the attainment of a common objective. Better use of the land is aimed not only at economic returns but at a permanently productive and pleasant environment. This environment is important to us only as it supports a human population and provides for its needs. And we need not only the food, clothing, and shelter the land provides. There must be areas for recreation and the aesthetic satisfaction obtained from a scenic view or a well managed landscape. There must be a place for our airports and turnpikes as well as new industrial, suburban, and other developments.

Thus members of the Soil Conservation Society of America participate in an endeavor of basic importance. Greater knowledge is needed in the science of using land and its components, whether soil, water, or the dependent living resources—cultivated crops, domesticated livestock, trees, grass, fish and wildlife. And more proficiency in practicing the art of good land use as a part of normal land management is part of our goal. In larger perspective, these things are a constructive, dynamic contribution to what many of our most thoughtful minds consider to be an unprecedented problem in human history—the adjustment of an explosively increasing human population to the total world environment and the natural resources it provides.

EDWARD H. GRAHAM, *President*

PLEASE NOTE NEW ADDRESS
(May 15, 1956)
SOIL CONSERVATION SOCIETY OF AMERICA
838 Fifth Avenue
Des Moines 14, Iowa

National Convention SCSA—Tulsa, Okla., Oct. 15-17, 1956



Tulsa, oil capital of the world, will be the location of the Society's Eleventh Annual Meeting. Headquarters will be at the Mayo Hotel. More complete information will be carried in the July JOURNAL.

The Eleventh Annual Meeting of the Soil Conservation Society of America will be held in Tulsa, Oklahoma, October 15, 16, 17. Tulsa is a beautiful city and is known as the oil capital of the world. In the July issue of the JOURNAL we hope to outline for the members of the Society many agricultural and conservation aspects of Oklahoma and surrounding states so individuals may combine travel to places of interest with attendance at the convention.

Tulsa has a population of 215,000 and is the commercial and industrial center for a four-state region which includes Oklahoma, Western Arkansas, Southwest Missouri, and Southeat Kansas. The history of the city dates from 1882 when the Frisco Railroad was extended from Vinita, Indian Territory, to Tulsa, then a small trading village of less than 1,000 population. The city was incorporated January 18, 1898, and the first government townsite survey was made in 1900, at which time the population was 1,390. Discovery of oil in nearby Red Fork in 1901 launched a boom development, and Tulsa boasted a population of 7,298 when Oklahoma became a state in 1907.

Within the memory of many still living the City of Tulsa has developed to the great center it is today. There are many places right in Tulsa to visit including the Philbrook Art Center housing original oils valued at $2,500,000; Boston Avenue Methodist Church, a modernistic cathedral of world acclaim; Thomas Gilcrease Museum, with the greatest collection of work of American artists on Indian life and culture; Mohawk Park and Zoo. Tulsa is the headquarters for the United States Junior Chamber of Commerce, the American Association of Petroleum Geologists, and the research center of many large oil companies.

Near Tulsa are many other points of interest including the Will Rogers Memorial at Claremore, the Mason Gun Collection at Claremore, world's larget collection. Nearby is Grand Lake. At Sapula the ladies will find a large glass and pottery plant.

A trip to the Eleventh Annual Meeting of the Soil Conservation Society of America will mean attendance at a meeting of interest to you in a professional way—but also there will be plenty of other interesting places, sights, and attractions for you. Plan an extra day but above all plan to be in Tulsa, Oklahoma, October 15-16-17. There will also be plenty for your wife and family planned.

South Dakota Chapter Holds Three Day Meeting

The Marvin Hughitt Hotel, Huron, South Dakota, was the site of the 1956 South Dakota Chapter meeting. The 160 members and guests gathered on February 1 for an evening smoker and smorgasbord under the direction of Bjorn Davidson.

On February 2 the following program was presented:

Safety Round Table—Representative of S. Dak. Highway Dept. and Dr. Glen Robeson, State Optometrists Assoc.

Welcome—Huron Chamber of Commerce

"Human Resources and the Conservationist"—Dr. E. Hixon, Chief Division of Agriculture, S. Dak. State College.

"Small Watersheds"—Fay Kerr, Chairman, Steering Committee, Richland Watershed.

"Education and Conservation"—Merle Switzer, Extension Soil Conservationist for S. Dak.

"Functions of State Committee"—Bernard Linn, Chairman, State Soil Conservation Committee.

Panel Report on National Convention—Lloyd Duerre, Jim Hughes, E. J. Daniel, Leroy Mernaugh, Vern Rusch.

"Water Resources and Conservation"—Joe Grimes, Chief Engineer, S. Dak. Water Resources Commission.

"News and Conservation,"—Chic Kircher, Managing Editor, The Farmer, St. Paul, Minn.

For the banquet, Warren Morrell, Editor, Rapid City Journal, spoke on "A South Dakota Editor Looks at India."

On February 3 the program continued:

"U. S. Geological Survey Information as an Aid in Conservation"—Harlan M. Erskine, District Engineer, U. S. G. S., Bimarck, N. Dak.

"The Soil Conservation Society of America"—H. Wayne Pritchard, Executive Secretary, Des Moines, Iowa.

"Soils, Grass, and Conservation"—Panel —Dr. O. L. Fine, Agronomist, S. Dak. Experiment Station and Soil Scientist, U.S.D.A.; Dr. W. W. Worzella, Head, Dept. of. Agronomy, S. Dak. State College; Dr. James K. Lewis, Ass't. Prof., Animal Husbandry, S. Dak. State College.

Address—Ben Reifel, Area Director, Indian Service, Aberdeen, S. Dak.

El Paso County Chapter Has a New Meeting Room

Left: Pictured is the new $45,000 Soil Conservation Center at Colorado Springs, Colorado. The building houses the offices of three soil conservation districts and a large meeting room used by the El Paso County Chapter No. 23, SCSA. Right: Chapter members Calvin Snyder, Divide, Colorado; Raymond W. Lewis, Banning-Lewis Ranch, Colorado Springs, Colorado, and J. Selby Young, Highland Hereford Ranch, Colorado Springs, Colorado, placing their brands on the paneling above the fireplace in the chapter meeting room. To pay for the fireplace and the tile floor the chapter sold "brand" space for $25.00 a square.

El Paso County Chapter No. 23, Soil Conservation Society of America, played an important role in the development of the new Soil Conservation Center at Colorado Springs, Colorado, and now has a new meeting room in the basement of the building. The project, while engineered in part by Society members, is under the supervision of the Fountain Valley, Central Colorado, and Black Squirrel Soil Conservation Districts. In 1946 the Soil Conservation Service granted the districts the old CCC buildings north of the city. During the war the buildings had been used as a CO Camp. The districts purchased 20 acres of land at that time for $2,000. Recently they were able to sell the land for $34,000 and the buildings for $2,800.

Proceeds from the sale were used to purchase an acre of land east of Colorado Springs on U. S. Highway 24 and to erect the new modern structure housing the district offices, personnel and equipment, as well as the new chapter meeting room of the Society. The building was erected at cost by Society members Harold Heyse and Ralph Watson. It has a current valuation of $45,000, is 40 feet wide and 70 feet long with an attached carport for 12 vehicles. The building has nine offices housing 18 individuals assigned to the three districts and the Kiowa Watershed Protection Project by the Soil Conservation Service.

Jasper D. Ackerman, Chairman of the Central Colorado District, has been elected by the three districts to handle finances relating to the building. Rent is paid by the Soil Conservation Service and others using the meeting room. The El Paso County Chapter pays rent each time they use the building. J. Selby Young, national council member of the Society is chairman of the Fountain Valley District. R. W. Hudson of Peyton, Colorado, is chairman of the Black Squirrel Soil Conservation District. Soil Conservation Service personnel include: Dearl Beach, Area Conservationist; Winfield S. Caton, Work Unit Conservationist for Central Colorado Soil Conservation District; Cyril Higginson, Work Unit Conservationist for Black Squirrel and Fountain Valley Soil Conservation Districts. Lena L. Stinnett is area clerk.

Winfield S. Caton, work unit conservationist for the Soil Conservation Service assigned to Central Colorado Soil Conservation District. All the land in the district is under agreement—363,371 acres. Caton received the Department of Agriculture Superior Service Award in 1953. He is chief cook for the El Paso County Chapter.

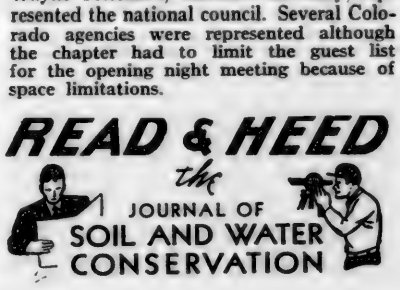
The three districts with offices in the new conservation center encompass an area totaling 750,000 acres. The Central Colorado District has a total of 363,371 acres with only 12 landowners—all district cooperators.

El Paso County Chapter Unique

The El Paso County Chapter No. 23 is unique in many ways but especially in that it has found it necessary to limit chapter membership. The chapter meets ten times a year to eat steak, baked potatoes, baked beans, salad, coffee, and cake as prepared under the direction of Winfield Caton. Everyone has a white apron with his name thereon. Following the dinners the group has a conservation program. Members come from all walks of life—ranching, business, industry, military, and professional conservation fields. The meetings have proven so popular that it has been necessary to limit membership to 96. Each member pays $32.50 a year with $20.00 budgeted for meals, $7.50 for local chapter dues and $5.00 for national dues. A long waiting list for membership in the chapter exists and it is only when someone moves from the community or dies that a chapter vacancy exists.

Fireplace "Launched" By Chalmers

On April 25 the chapter dedicated their new meeting room in the basement of the Soil Conservation Center. The chapter made the arrangements to build the fireplace, cover the floor with block tile, and equip the kitchen with latest facilities. Kenneth Chalmers, State Conservationist of Denver, was present to break a bottle of champaigne on the mantle of the fireplace to officially dedicate the new meeting room. Don Daily, former executive secretary of NASCD and now Executive Assistant to Governor Johnson of Colorado, spoke briefly at the meeting. H. Wayne Pritchard, executive secretary, represented the national council. Several Colorado agencies were represented although the chapter had to limit the guest list for the opening night meeting because of space limitations.



SOME NEW INDUSTRY PRODUCTS

Case "300" Has Twelve Forward Gear Speeds

A new three-plow tractor, the Case "300," has a triple-range transmission with 12 overlapping gear speeds forward, plus three reverse. Purpose is to provide perfect matching of travel speed to crop condition at constant PTO speed as needed for harvest machines; also for greatest capacity and best economy at all combinations of speed and load in tillage work. Buyers have choice of diesel engine or high-compression gas engine with models for gasoline, LP gas and distillate. All have lugging ability to pull full load down to half-speed, temporary 12 per cent overloads at two-third speeds. Besides usual gauges, the "Tell-Easy" instrument panel has hour meter, speedometer and tachometer that shows engine r.p.m. and correct PTO speed. Both general-purpose and low-profile utility models have Eagle Hitch three-point hook-up that provides easy implement attachment and transport besides stabilized plowing depth and traction.

Ford Announces New Adjustable Rear Blade

A versatile six-foot adjustable rear blade designed to mount on all Ford tractors and featuring tilt, pitch and offset adjustments as well as blade angling, is announced by the Tractor and Implement Division, Ford Motor Company.

The new Ford adjustable rear blade angles 45 degrees each side of center with seven-hole stops, and tilts 40 degrees each side of center with nine holes. Blade pitch is adjustable to 10 degrees plus or minus by means of an adjustment at the rear of the blade, with intermediate pitch adjustments made with the Ford tractor's adjustable top link.

The blade can be used by contractors and farmers to level yards and lots prior to seeding, grade drives, lanes, roadsides and building areas and to scrape snow, backfill gullies, ditches and excavations, terrace fields or rebuild existing terraces, ditch fields for irrigation or drainage, and clean barns, barnyards and ditches.

Available as accessories are gauge wheels, end plates, skid shoes and ditching points.

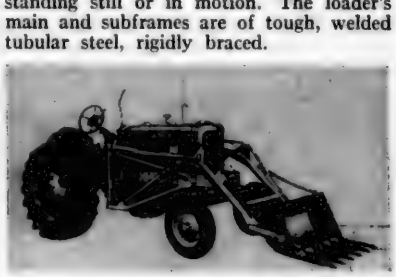
A high carbon steel reversible and replaceable cutting edge is designed for long life and low maintenance costs, while a welded steel frame provides greater strength.

The blade attaches quickly and easily to the three-point implement linkage of all Ford tractors, including tricycle models, as well as the Fordson Major Diesel.

Cutting width and overall width are 72 inches, transport clearance when raised by the tractor hydraulic system is 18 inches, overall length is 48 inches, overall height is 48 inches, blade height is 18 inches and weight is 360 pounds.

Allis-Chalmers Adds New Front-End Farm Loader

Allis-Chalmers recently announced the addition to its implement line of a hydraulic front-end farm loader for mounting on the CA, WD and WD-45 tractors. Designed especially for these Allis-Chalmers tractors, the loader is available in two sizes both hydraulically operated and featuring quick drive-in attachments and easy back-out removal which always makes the tractors available for other work. Model 8 loader is designed for the CA tractor. It has a thirty-six inch wide, eight cubic foot capacity bucket, with a maximum lift of eight feet. Model 9 loader is for the company's WD series tractors. It has a ten-foot lifting height for its 40-inch wide, nine cubic foot capacity bucket. Both buckets are equipped with slide-on dirt plates and tough, replaceable 1⅛ inch square steel tines. The loader can be operated without shifting tractor gears and when tractor is either standing still or in motion. The loader's main and subframes are of tough, welded tubular steel, rigidly braced.

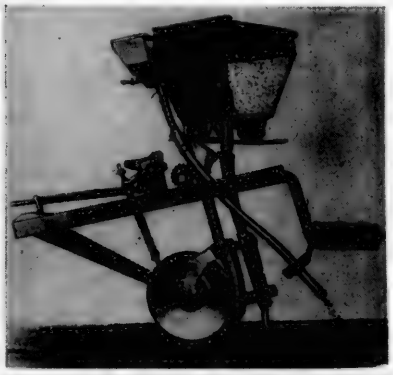


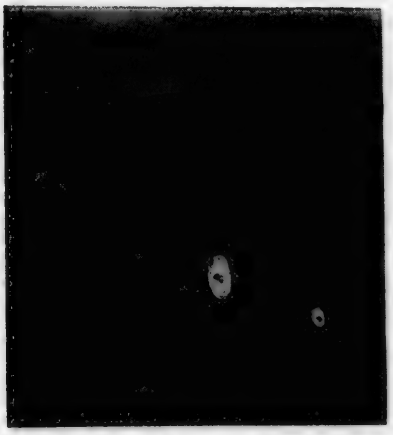
Best Way to Seed Grasses, Legumes

Farmers who band-seed grasses and legumes are getting faster growing, more uniform, and more vigorous stands from greatly reduced rates of planting.

The accompanying cutaway pictures a John Deere fertilizer-grain drill with band-seeding equipment. It illustrates the best placement of fertilizer and seed for highest production.

As grain drops through a tube and spout to the bottom of the seed trench, fertilizer descends through another tube and spout onto a thin layer of soil above the seed. Grass or legume seed, or a mixture, then is drilled in a band on top of the seedbed directly over but not in contact with the fertilizer. The seed drops through a flexible, smooth-bore tube extending from the seeder to within two or three inches of the ground. Press-wheel attachments may be used to provide shallow coverage of the seed. Covering chains are not used because they would scatter the tiny grass and legume seeds away from the band of fertilizer.





New Rotary Chopper Serves Many Uses

The new John Deere No. 10 Rotary Chopper is a multi-use machine which should prove profitable on many farms. Low in cost and big in capacity, the No. 10 chops standing or windrowed hay for drylot feeding or for silage. Featuring offset operation, neither the chopper nor the tractor powering it run down the crop.

Among other jobs, the No. 10 tops beets for silage—chops, shreds, and spreads brush, orchard and vineyard trimmings—shreds cotton, corn, and other stalks, aiding in pest control and cleaner plowing—chops straw and stalks into bedding—makes silage of sweet corn stalks—and clips pastures.

With its simplicity adding to its strength, the new John Deere No. 10 Rotary Chopper consists of a rotor with four rows of eight curved, free-swinging knives which cut a 5-foot swath. They cut, chop, and lift the field growth being harvested into a big-capacity auger where it is quickly whisked into a blower for delivery into the trailing wagon or truck.

By leaving the auger housing door open shredded crop residues may be deposited on the ground behind the machine.

Disc Harrow By Allis-Chalmers Is Well Built

Allis-Chalmers has introduced the No. 210 10-foot double-action disc harrow to its line of "Big-Capacity" implements for its WD-45 and WD tractors.

The 10-foot harrow has been designed especially to take full advantage of the company's fundamental advancement of automatic traction booster and the new remote ram principle. It is very similar to the larger 12½-foot disc harrow Allis-Chalmers introduced this past summer in conjunction with its announcement of its new engineering principle which extends the use of automatic weight transfer to the operation of larger and heavier implements and automatically transfers to the tractor's drive wheels as much of the harrow weight as may be needed for traction.

Features of the new harrow include *Snap-Coupler* hitch; double-sealed *Bal-Pak* anti-friction gang bearings, grease-packed at the factory for the life of the bearings; flexible frame permitting attached members and gangs to follow ground contour; full hydraulic control; heavy-duty No. 10 gauge steel, heat-treated disc blades; high-carbon steel gang bolts, 1-in. in diameter; cast iron, precision-ground spools and adjustable scrapers of special high-carbon steel. The transport wheels are mounted on tapered roller bearings and attached to the cross shaft by sturdy bar-type axles.

MM Foragors Are Improved

A new direct-cut header, with 72-inch cutting width, for the MM tractor-drawn Foragor and the Uni-Foragor was recently announced by Minneapolis-Moline Company.

A welded frame gives rigid support to the all-steel header.

The adjustable sickle bar can be tilted for the best angle of cut in varying crop and ground conditions. The adjustable shoes on the sickle bar can also be raised or lowered for control of stubble height.

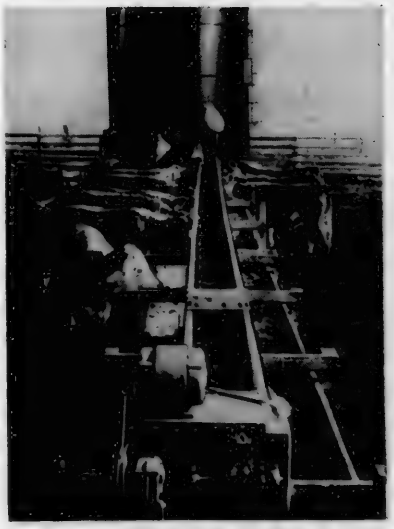
The outer crop divider is hinged to float over uneven ground, and shaped for efficient separation of the swath to be cut.

Double raker-bar assemblies, operating on two crank shafts, provide continuous feeding of the forage crop from sickle to chopping knives. Between the raker bars, hold-down rods provide an even thickness of material.

Slip clutches protect both sickle and raker-bar drives, which are operated by steel roller chains. Main drives run on sealed ball bearings and roller bearings.

Plow Has Many Advantages

With an Oliver Be-Ge Reversible Disc Plow you turn right back into the furrow you've just made. Only one furrow is opened. Upon raising the plow, the blades are automatically reversed to throw the dirt in the same direction on the return trip. You save empty travel at field ends and useless circling. You same time and tractor fuel. This plow can be attached to any standard three-point hitch quickly and easily. Just lift the ball sockets to the pins, attach the top center link with the pin supplied, and your Oliver Be-Ge Reversible Disc Plow is ready for the field.



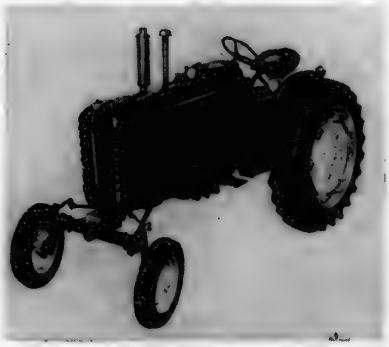
Harvestore Mechanical Feeder

As another step in the progress toward mechanized cattle feeding, which was begun with the Harvestore and its unloader, A. O. Smith Corporation now is offering the Harvestore Mechanical Feeder, which can progressively fill bunks with roughage or grain sufficient to feed 250 beef or dairy cattle at a time.

The Harvestore, manufactured by the Harvestore Division, is a glass-coated steel silo-like structure with a wide variety of uses in storage of agricultural and industrial products, owing to its control of moisture and exclusion of oxygen.

The new mechanical feeder is a conveyor extension from the bottom unloader. Tooth-shaped cross-flight feed conveyors, actuated by chains, scrape the feed rapidly along the trough. Slots in the floor of the trough permit the feed to drop into the bunks lining each side. The amount distributed can be varied by opening or closing the slots.

The self-reversing discs are engineered by the Oliver Corporation to penetrate the hardest ground to the depth desired quickly and easily. The plow is light in draft, yet amply sturdy to furrow up to 15 or 16 inches deep under practically any soil condition. It eliminates side draft or skipping regardless of which way the dirt is thrown.



New Massey-Harris Tractor

The new 333 tractor by Massey-Harris features a completely new 208 cubic-inch engine and succeeds Massey-Harris' popular 33. A 3-4 plow tractor machine, it features a 10-speed Hi-Lo transmission, power-adjusted rear wheels, optional power steering, level-drive power-take off and Massey-Harris three-point Hitch-All with exclusive wrist-action.

Drainage Gate Has Many Uses

The Snow Automatic Drainage Gate, manufactured by Snow Gates and Valves, is adaptable to many uses including draining low lying land and preventing backflow. It is also used on pump discharge lines.

This cast iron gate is of heavy construction with machine ground seating surfaces. The cover is double hinged and supported by heavy steel link bars fully adjustable at the frame. The cover, being balanced, is sensitive to low water pressures.

By locking the link bars with cotter pins at the cover, the Drainage Gate is converted to a Flap Valve for use where conditions warrant. It prevents the cover from being wedged in the bottom of the frame opening and thus making the gate inoperative.

Engineered for...

BIGGER GRASSLAND PROFITS!

In today's changing farm pattern, there is a special need for equipment to help farmers make the most of their grassland acres.

Conservation . . . new acreage shifts . . . plus the need for lower-cost feed . . . bring grassland farming into sharp focus. Today's farmer knows he must have power equipment designed to pay its way on the family-size business farm under those conditions.

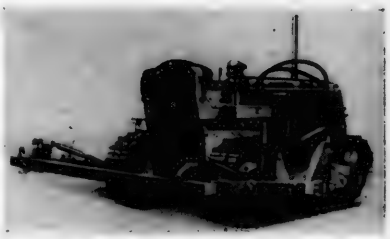
The Allis-Chalmers Forage Harvester is the performance leader for today's new pattern of agriculture. It delivers big capacity at low price to cut the cost of livestock feeding, plus flexibility . . . one machine for harvesting standing, windrowed or row crops.

Allis-Chalmers design assures smooth, easy movement of forage all the way through the machine. Wide-flow feeding requires less power . . . and fuel. Big-throated action of the 3-foot-wide cylinder — with exclusive spiraled, cut-and-throw knives — makes the difference. Knives are power-sharpened right in the machine. Rear or side delivery, as desired.

For complete information, see your Allis-Chalmers dealer, or write for free illustrated literature.

ALLIS-CHALMERS, FARM EQUIPMENT DIVISION
MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS



Tool Bar Arrangement

Caterpillar Tractor Co. has announced a new attachment for its D6 Tractor that will make this machine a more versatile tool on the farm. This new addition to the company's expanding line is the No. 6 Tool Bar and Tool Bar Bulldozer arrangement.

The No. 6 features the same type of "swing-around" draft members as the No. 2 and No. 4 Tool Bars. A farm dozer blade is also available in the new arrangement. The dozer is ideal for small farm pond building, land clearing and other earthmoving tasks around the farm. Adjusting screws afford a tip-tilt feature to the dozer blade, making ditch building and cleaning easier.

Quick disconnect beam clamps for easier, faster beam changes and the welded box section 4½" by 7½" beam which provides an excellent mounting for deep tillage tools, are among the features on the new No. 6.

Mounted Automatic Scooper On Allis-Chalmers Tractor

A two-way tractor-mounted one-half cubic yard reversible scoop has been added to the Allis-Chalmers line of farm equipment engineered and designed for its WD-45 tractor. It is a rear-mounted implement with snap-coupler hitch.

In addition to earth-moving when building farm ponds and reservoirs, filling gullies and ditches, maintaining farm and access roads, lanes and terraces, the new Allis-Chalmers scoop is also an ideal tool to speed and facilitate handling of farm materials such as bulk or sacked feed, fertilizer, lime, field stone and other materials. It also can be used for snow removal, cleaning ditches, barns, feed lots and for other farm work, making it versatile, year-round implement that will save farmers innumerable hours of valuable time and effort.

Two HARVESTORES and VERTICAL FARMING

doubled the "size" of dairy farm without adding a single acre

- **Cattle number — increased from 39 to 100**
- **Acreage requirements per cow — cut from 3.1 to 1.7**
- **Milk production — boosted 62%**
- **Butterfat content — increased 70%**
- **Feeding costs — concentrate needs cut to half that of typical non-Harvestore farms in the area.**

Mr. V. L. Blakely, Delavan, Wisconsin

● V. L. Blakely, Delavan, Wis., now has a "bigger" farm on the same acreage by putting lazy acres to work.

And he did the job through vertical farming without adding a single acre. He still cultivates the same 140-150 acres as before.

"This increase in cattle," Mr. Blakely says, "normally would mean more acres to work and more help to maintain. But there's just the three of us on the farm — my wife, 9-year-old son and myself. And, of course, the two Harvestores."

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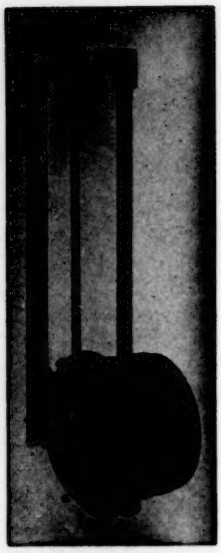

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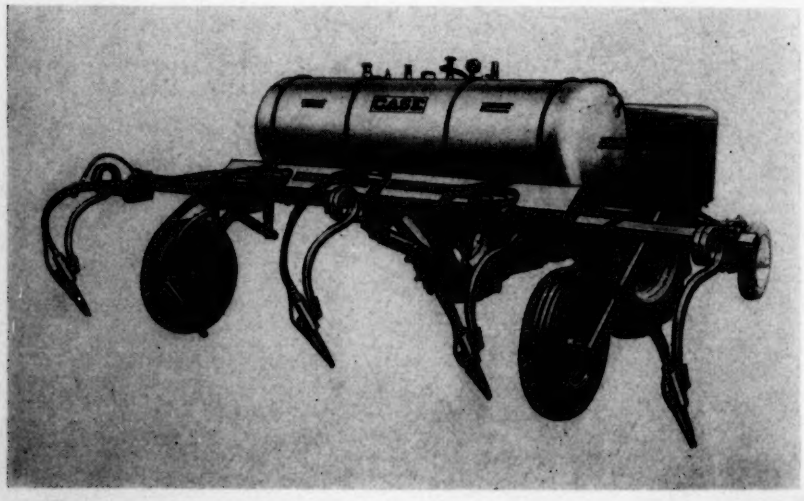
"Live Openers" are the principal feature of the new Case Model G-8 Ammonia Applicator. The "live openers" are rotating spindles used to penetrate and loosen the soil for more thorough application and covering. Field experience during 1955 indicates that rotary spindles are superior to knife openers. "Live openers" assure more soil-held ammonia by ejection into loosened soil and immediate covering. Different than most conventional applicators, the Case Model G-8 does not require rear press wheels.

Besides greater ammonia fixation, the P.T.O. driven "live openers" mean less draft since there is less drag or pull behind the tractor. Field operations of the Case G-8 Applicator were scientifically tested with the Case mobile electronic laboratory to confirm the extraordinary light draft feature.



Index to Advertisers

Goodyear .....Inside Front Cover
Oliver Corporation ....Back Cover
J. I. Case Co.....Inside Back Cover
Austin-Western Works..... 101
Ford Motor Co..... 102
Caterpillar Tractor Co..... 104
Climax Molybdenum 105
John Deere 106
New Holland 107
Ferguson 108
Massaglia Hotels 142
Town House 142
International Minerals & Chemical Corporation 143
Allis-Chalmers 150
A. O. Smith Corp. 151
Snow Gates & Valves..... 152
National Rain Bird Sales and Engineering Corp. 152

3 NEW CASE COLOR FILMS ON FARM MECHANIZATION

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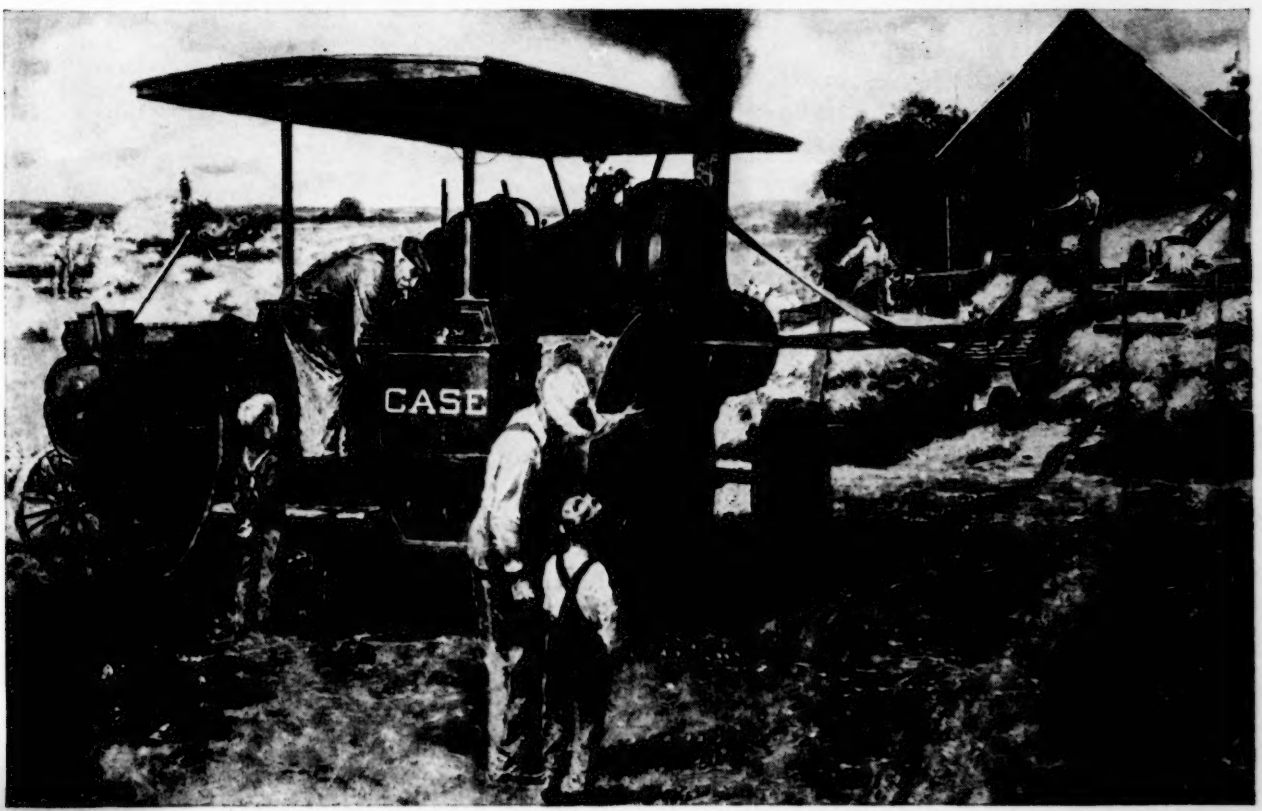

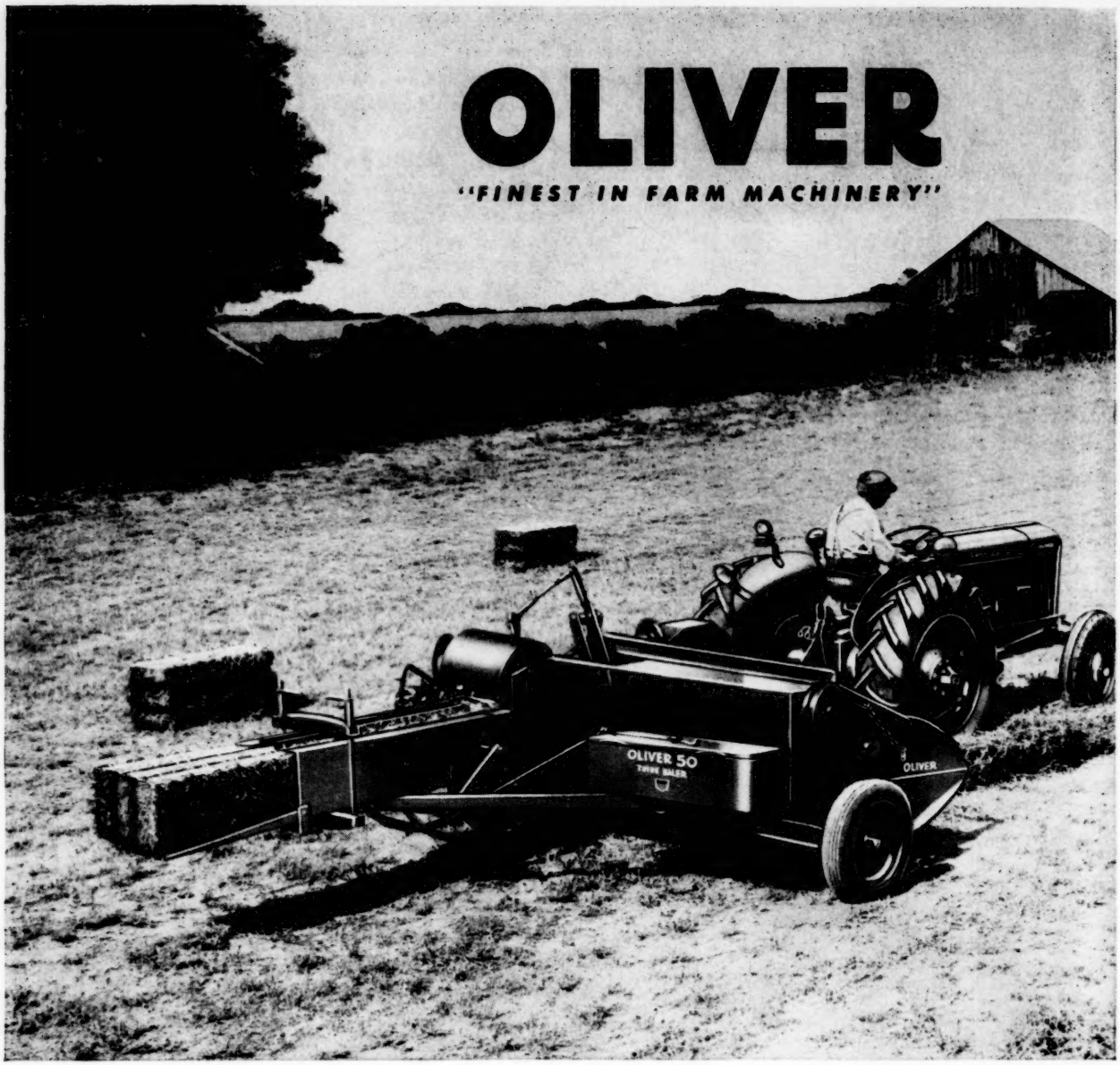

The Oliver Model 50 Twine-Tie Baler

Simple design pays off in the bale

This is a time when dollars count. Nowhere do they count more heavily than in the farmer's baling operation—where all depends on getting that perishable crop in fast. A new baler is his best insurance of haying profits. Best of all, an Oliver; then the payoff is doubly sure.

Take this Oliver Model 50 Twine-Tie Baler. See how simply it's designed? You have only to look at a bale to see where that simple design pays off.

Notice the quality. This hay was baled at just the proper stage. The instant the crop is "right," the Model 50 moves fast and keeps moving. A sturdy machine which has fewer parts to go wrong.

Notice the leaves. They're there, *in the bale*—the valuable proteins with them. That's because the Model 50 takes the hay from windrow to bale with an absolute minimum of handling. Up...across... out. Again, *simple design.*

And capacity! Simple design means that all weight is *working* weight—the Model 50 bales up to nine tons an hour. (And how effortlessly when attached to an Oliver Tractor's Independently Controlled PTO!)

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